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NOTES ON THE PRESENT STATUS OF THE NORTHERN ELEPHANT SEAL, MIROUNGA ANGUSTIROSTRIS

BY A. W. ANTHONY

[*Plates 17–20*]

In 1869 Scammon, writing of the elephant seal, mentioned it as nearly, if not quite, extinct,[1] a condition that must have prevailed several times since that date if we are to believe all that has been printed. As a matter of fact we have known very little of the animal and the most interesting pages of its history are yet to be published.

It is with the idea of placing on record my recent notes on the species, rather than with any claim to their completeness, that I offer the present paper.

Recently it was my good fortune to gain possession of an old log book of the several voyages of certain sealing schooners which cruised the coast of Lower California and its islands, giving many valuable data on the last days of the Guadalupe fur seal (*Arctocephalus townsendi*). In several of its pages I find such records as: "went prospecting for elephants and found nix." These dates were in the early eighties and at about the same time that Dr. Chas. H. Townsend took what, at that time, was considered to be the last of the elephant seals. In conversation with me, a few years later, Doctor Townsend told me that he had cruised all of the former haunts of the animal, as far south as San Cristobal Bay, and had given up hopes of finding specimens when, at that, the most southern of its recent hauling grounds,

[1] Proc. Acad. Nat. Sci., Philadelphia, April, 1869, pp. 61–63.

he fell in with a small herd of 16 which were collected for the National Museum. This action was considered justifiable at the time, as the species was considered doomed to extinction by way of the sealer's trypot and few, if any, specimens were to be found in the museums of North America.

In 1892 Doctor Townsend and myself were sent to Guadalupe Island by the State Department to secure evidence of the occurrence there of fur seals, and found, to the surprise of all naturalists, nine of the supposed extinct elephant seals. Acting again on the plan of saving them from the oil barrel, we shot seven, only three of which we were able to take from the beach, owing to the heavy surf.

In 1907 Chas. Harris took several specimens on Guadalupe Island, most of which were sent to the Rothschild Museum. Mr. Harris told me that there were "a few left that he did not shoot."[2] This brings the history to the date of the Albatross expedition in March, 1911. At this time Doctor Townsend found "about 125" animals at the only hauling ground known on Guadalupe, where we found them in 1892. Unfortunately the sensational articles published by the daily press, following the news of this elephant herd, led the average beachcomber to think a fortune lay in each and every skin that could be taken from the island, a romance that caused the needless slaughter of an unknown number of elephants, the skins of which were valueless. The needless killing of so many animals, with no profit to anyone, led the authorities at Washington to issue an order forbidding the importation of skins unless accompanied by a written permit from the capital, at Mexico, which act no doubt saved, for the time, the last remnant of the race.

In July, 1922, I was invited by the Mexican Government, which paid all of the expenses of the voyage and furnished the patrol boat "Tecate," to go to Guadalupe and the coast islands, as far south as Magdalena Bay, for the purpose of making a survey of the marine life. We were accompanied by Srs. Carlos Cuesta Terron and Jose M. Gallegos, of the National Museum of Mexico, and Dr. G. Dallas Hanna and J. R. Slevin of the California Academy of Sciences.

At the long established rookery at Guadalupe we found, to our gratification, not less than 264 adult males. As there were five or six "pups" seen when we first landed, which soon retreated to the water, there may have been a few females. However, a complete

[2] Doctor Townsend records that Harris saw about 40 animals and killed 14. Zoologica, New York Zool. Soc., vol. 1, no. 8, April 15, 1912.

census of the herd an hour later failed to reveal any of that sex, nearly all being adult or nearly full grown males, the younger males being as conspiciously absent as the females.

About 800 yards northeast of the sand beach used by the elephant seals was found a large cave, the entrance to which is open only at very low tides. Elephants could be heard in the cave and some twenty-five or more were seen in the water near the entrance. All of those in the water were adult males.

In September the Mexican Government sent the "Tecate" to Guadalupe to post a large sign in both Spanish and English, informing those that might land at that point that a heavy penalty followed the killing or capture of any elephant seals. At this time the tides were more favorable for investigating the inside of the cave and the officers reported to me some "150 females with small young" inside on the sand. Without critical examination it is quite difficult, if not impossible, to separate the young males nearing maturity from the adult females, so, perhaps, the above report might be regarded as not conclusive.

The entire island of Guadalupe was circumnavigated, in constant expectation of finding a hauling ground of the females and young. No suitable beach exists along these shores, however, as the animal, in my experience, avoids any but sand beach, all rocky and steep shores being unsuited to its requirements.

Continuing the voyage to the south, we confidently expected to find some further hauling grounds where the females might be seen but, though all of the shores as far south as Latitude 24°, 30′ north were carefully examined, we found no evidence of recent occupation.

At the San Benito Islands elephant seals have been seen several times of late years, the records being for May and October, several animals being seen in each instance. The sex, however, was not learned.

Scammon states that in the early history of California the species was abundant from the latitude of Santa Barbara to about 25° north but was soon reduced to but a remnant of its former numbers by the whalers who killed them for the oil, a full grown bull yielding as much as 210 gallons.

At San Benito Islands and at the south end of Cedros Island we found abundant evidence of the slaughter in the crumbling bones that marked the rookeries of over half a century past. The fact that animals have recently visited the oldtime hauling grounds leads one

to hope that these may again be resorted to and the limits of the herd, at present confined to Guadalupe, greatly increased.

In July, 1923, I again received an invitation from the Mexican Government to visit the rookery at Guadalupe and note what changes had taken place during the past year. The hauling ground was reached July 16 and a careful count made of the animals there. As near as might be enumerated we found 366 of all ages and as a year ago but four or five that were not over a year old. On both visits to this rookery several young animals were found dead and half buried in the sand. The adults are frequently seen, as they pass to and from the water, climbing over their closely crowded fellows and it can easily be seen that a "pup" would stand small chance of survival if walked on by one of these monsters. This may quite possibly be one of the reasons for the separation of the sexes during the period when the young are comparatively helpless.

Townsend states (Zoologica, vol. 1, no. 8, p. 163) that at the time of his visit, March 2, 1911, there were only six females on the beach accompanied by newly born young, which would prove that some, at least, are born on the island. It seems to me unlikely that between that date and July the females should have joined the males at Guadalupe and the young become strong enough to leave the island with the bulk of the younger animals and all the females, for at all times that I have any records of the hauling grounds the immature animals and females of all ages have been conspicuously absent.

Until the missing members of the herd can be found and counted an accurate census is, of course, impossible. Until such time as they may be found it might, perhaps, be permissible to speculate as to their probable numbers. Estimating the adult females as equal to the males seen in July, 1923, we would have not less than 700, not counting the many that must have been absent from the beach at the time the count was made. As a matter of fact quite a number were seen some distance to the southwest and were not included in the count, nor were those of uncertain number known to be in the cave mentioned above. Many must reasonably be absent on feeding expeditions, to all of which should be included those that have not reached the adult age of, perhaps, eight years. I would consider that 1250 would be a conservative estimate of the Guadalupe herd.

The shores of Guadalupe abound in caves, many of which may be examined at low tide, while others are no doubt accessible only by an entrance below the water known only to the seals. In some such

caves the lost members of the tribe of *Mirounga* may find sanctuary and if so it quite possibly explains the failure on the part of the whalers and sealers of the past to exterminate the species.

Miss M. E. McClellan, of the California Academy of Sciences, San Francisco, has called my attention to the following, that may be of interest in this connection:

> When Mr. Harris reported the existence of the small herd of the Northern Sea Elephant on Guadalupe Island and I requested him to procure specimens, he made the, to me, startling announcement that he must reach the island before the middle of May or the Sea Elephants would have migrated to the south. I looked up the matter and found that, although a few stray individuals might formerly have led a pelagic life north of the equator, the bulk of the Northern Sea Elephants migrated in the hot weather to the Chilian coast and the islands near (Juan Fernandez, Nasafuera, etc.).[3]

Since many of the elephant seals are to be found at any time of the year, and, seemingly, the bulk of the herd during at least eight months—February to September—I can hardly look for evidence of a migration so far south as the coast of Chili. The unsatisfactory literature at hand gives me no clew as to where the above evidence was obtained.

Of the ten specimens that I have assisted in collecting only one gave any indication of the probable food. A young male, three quarters grown, had recently bolted a bass of about two pounds weight. This, with a few fragments of kelp, taken perhaps at the same time as the fish, and a few pebbles were the only stomach contents. The fish was not masticated.

All of the stomachs that I have examined contained more or less sand and gravel and in some were found stones an inch or more in diameter. In several animals we found large quantities of parasitic worms of about two and a half inches in length and of the diameter and general appearance of common angle-worms.

The eye of the northern elephant seal suggests nocturnal feeding habits, being remarkably large and full, the iris measuring in the adult male two and a quarter inches in diameter, a perfect circle dark brown in color, with large arborescent veinings of lighter color springing from the edge of the pupil, such as may be seen in the iris of the horse. The pupil is an oval measuring one and an eighth inches by one half inch, with the long diameter vertical as in the cat tribe.

[3] Rothschild,—Notes on Sea Elephants. Novitates Zoologicæ, vol. 17, 1910, pp. 445–446.

All of the seals approaching the hauling ground at Guadalupe spend considerable time in the water before hauling out, which may account for our finding so little food in the stomachs examined, digestion having advanced before the animal came out of the water. In floating, the animal may lie with both head and hind flippers out of the water, or, as is often seen, upright with head and neck three feet or more above the waves; again only the top of the head may be seen.

In common with the members of the genus *Phoca*, the northern elephant seal propels itself with the hind flippers, which are used, as in *Phoca*, as a fish uses its tail; but, somewhat unlike the harbor seals, the two limbs are not held in close contact but are much more separated, a pliant, powerful pair of propellers that drive the animal forward at a fair speed, while the front flippers are held close against the sides. On his coming to the surface the short, powerful front limbs are in constant use to maintain an upright balance. I think that this species can and does remain below the water longer than any of the pinnipeds with which I am familiar. A yearling animal under observation in the San Diego Zoological Garden has been timed with a watch for six minutes, during which time it rested on the bottom of the tank with front flippers folded against the sides—to all appearances dead. On coming to the surface the breath was expelled quickly, following which there were ten or more deep inhalations in rapid succession. That the adults have a similar habit of resting on the bottom in front of the hauling ground at Guadalupe Island I have no doubt.

The disproportionally short front flipper is a very powerful and remarkably handy member. The claws, which are absent from the hind limbs, are flat and heavy. The joints are nearly as flexible as those of the human hand. Animals on the beach were frequently seen scratching those parts of the body in reach of the flipper, the action being exactly that of a man's hand. The reason for such frequent scratching is hard to explain unless it be that the moulting, which was at its height at the time of our visits, may have caused the irritation. No parasites were found on the several seals examined.

On coming out of the water and selecting a spot for a nap, the animal usually shovels a quantity of sand over the back, using the front flippers as excavators and throwing the sand five or six feet in the air. Often seals were seen with sand banked a foot high along the sides, where it had slipped off the back, while the dorsal surface carried all that could be made to stay there. As the sand on the beach

is damp and cool it is reasonable to suppose that it is used as a protection against the rays of the sun.

While many of the former hauling grounds of this species are exposed to the burning heat of a semitropical sun and the members of the herd at present found on Guadalupe spend a large part of the time in exposed situations, I have always found the cave, some 800 yards north of the hauling ground, well stocked with elephants that seemed to enjoy thoroughly the semidarkness and cool shade of the sand beach at the further limits.

Several times I have approached a sleeping elephant seal and awakened him by a slap on the back and had the compliment returned in the form of several pounds of coarse sand delivered with almost the force of birdshot, to be repeated as I sidestepped to get out of the firing line and the animal shifted as quickly to bring me again in range. Clearly the barrage was intended as a defence and as the seal was looking back at me it was clear that he realized his line of fire must be changed as I moved. Nor is the sand when used as ammunition thrown high in the air as when intended for a sun shade, it is fired with many times the force and at a low angle.

I am unable to state just when the moult begins. Animals were found in early May showing a ragged coat and with the moult somewhat advanced. July finds many, if not most of the younger males, with dark gray coats of short, new hair and little if any of the old pelage; while adult bulls are still in full moult the last of July. The entire cuticle is shed with the old hair, often in patches as large as a man's hand. The hair is about three millimeters in length on the flesh side of the cast off garment and two to six millimeters on its outer surface, depending on the part of the animal from which the fragment was cast, the shorter pelage being on the flippers and head, and the longer, which is rather stiff and coarse, on the sides and back. The sand of the hauling ground at Guadalupe is littered with fragments of cast off cuticle during the entire summer months.

Mention has been made of the more advanced moult in the young animals. I think there must be at least three month's difference between the younger males, just beginning to develop the elongated proboscis, and those fully developed. The latter were seen in late July, in tawny, yellowish coats, tattered and hanging in strips about the neck and shoulders, which are the first parts to show the moult. At such times the animals suggest a bad case of sunburn with the bare skin of the neck showing bright pink.

It is pleasing to note the efforts that the Mexican Government has made to protect the fauna of Guadalupe, especially the elephant seals. At the present time there is a squad of soldiers at the old barracks, at the North Landing, with a guard on the cliffs, overlooking the Elephant Beach. A large sign, at the hauling ground, informs landing parties that the animals are not to be molested and the guards have orders to shoot first and ask questions at some later date. This somewhat drastic action may be better understood when it is known that a whaling ship recently sailed from San Francisco with the intention of taking the entire herd for oil. They were only prevented by ignorance on the part of the captain who supposed that the seals were found on an island in the Gulf of California, where he spent some weeks looking for elephants that were not to be found. At another time a company operating a fertilizer factory applied to the California Academy of Sciences for information as to the location of the herd, stating that it was understood that there were enough to keep the plant running a few days, and if given the required data they would "clean them up."

Guadalupe Island is now a Federal Reserve and the Mexican Government is earnestly trying to protect its fauna. Landing at Guadalupe Island is permitted only under written order issued by responsible representatives of the government.

San Diego, California.

A "pod" of elephant seals in the sea

The Guadalupe herd asleep on the sand

NORTHERN ELEPHANT SEAL

Photos by J. M. Gallegos

The beginning of an argument

A common posture, showing the length to which the neck may be extended.

NORTHERN ELEPHANT SEAL

Photos by J. M. Gallegos

Adult male elephant seal. Photo by J. M. Gallegos

The author striking a male in the face with his cap, to force it to raise its head. Photo by A. Gordillo.

Old male asleep, showing relaxed "trunk"

Male with sand on his back. This animal had shed nearly all the old cuticle except one or two patches near the hind flippers. The new hair is still very short.

NORTHERN ELEPHANT SEAL

Photos by J. M. Gallegos

THE PRACTICE OF HYGIENIC CONTROL AND ITS RESULTS AT THE PHILADELPHIA ZOOLOGICAL GARDEN[1]

By Herbert Fox, M.D.

The maintenance of a zoological collection for the study of the lower animals and the entertainment of visitors demands a strict observation of hygienic rules applied in a common sense manner. There are a few specific things that may be done for the prevention of certain diseases but for the most part regulations must be adopted that will have a wide influence in the selection for exhibit of healthy specimens and maintenance in health of those selected. We know too little of the diseases to which lower orders are individually susceptible, and there are too many of these varieties, to attempt selective protection for each one. In human medicine there is one variety with well known susceptibilities, in veterinary medicine there may be ten varieties, but in wild animal collections there may be, as in the Philadelphia Zoo, forty orders with as many different infectious states. Not knowing all these and therefore not being able to combat them, our hygienic measures must be, with few exceptions, universally applicable. Let us hope that the time will soon come when the diseases of all these varieties will be known, for then we shall be much helped in human medicine.

Realizing the limitations of our knowledge of wild animal pathology and appreciating the need of scientific study of disease and hygiene in zoological gardens, the directors of the Philadelphia Garden established in 1901 a laboratory of comparative pathology. During the years that have elapsed not only have scientific data been collected but practical experience has been gained in the understanding and management of the health of wild animals. It is my purpose to discuss the customary measures in practice at the Garden, to describe what is done in event of single or multiple infectious cases and lastly to relate some notable successes in the preservation of specimens, such as the eradication of certain chronic enzoötics.

Let me begin by saying that the therapeutic handling of disease in lower animals is very unsatisfactory. The action of a drug is not always the same in different groups, perhaps being without effect in one, toxic to another. Then again, wild animals can seldom be handled with safety to themselves, as well as to the keepers, for many an injury has

[1] A lecture given in the Public Health Course, University of Pennsylvania, November 17, 1923.

been suffered by the simple attempt to transfer from one enclosure to another. Naturally wild animals are not coöperative.

Diagnosis is exceedingly difficult in lower animals for several reasons, the most important of which is the great natural reserve they possess, so great indeed that they may appear in excellent condition on one day to be dead the next, and present at postmortem well advanced lesions. Because they cannot be handled with ease, physical examination is very limited. This does not mean that it is neglected, for many specimens are caught in boxes, nets or the gloved hands, but the findings are often vague or not easily interpreted. The facts of the matter are that we are usually aware of the existence of a communicable disease only when the beast comes to autopsy. Then our hygiene begins. What these measures are will be discussed at appropriate places. There is one generally applicable procedure of the greatest value in preventing the spread of infection among animals and one that doubtless many a public health official has frequently wished for, that of sacrifice. This measure has been used many times in individual disease outbreaks and in tuberculosis but not to whole groups in one enclosure, although we would do it unhesitatingly if it seemed necessary. Perhaps this power of life and death over our patients makes up for the lack of coöperation and intelligence, presumably but not always at the disposal of the hygienist in human medicine.

We attempt to isolate all specimens when infectious states are suspected and we practice it absolutely for groups of animals that come frequently with communicable disease from dealers. Thus all small mammals, notoriously susceptible to distemper, are segregated for one week at least, and longer if they exhibit catarrhal symptoms on arrival. Under the latter condition antidistemper serum is injected. Old world parrots well known to harbor gastric worms are quarantined until they are proven by microscopic examination to be free of parasites. Obviously it is impossible to quarantine in separate enclosures all individual specimens. When a large shipment arrives closely packed together in one case, considerable effort is made to segregate them since it has been known that crowding not only facilitates the passage of a virus but reduces the resistance of an individual. A large shipment of quail put into a small enclosure all succumbed to quail disease while another similar group segregated and given plenty of space suffered very little. Surely such an experience will find its analogue in human medicine. If a shipment come from a source in which we are aware of the presence of infection, appropriate quarantine or segregation is practiced or the con-

signment may be refused altogether. The tuberculin test, to be discussed later, acts as a quarantine measure for the primates.

The value of all quarantine measures is exceedingly difficult to gauge and can be satisfactorily perceptible only when we are aware of the cause and transmission of a disease and have at the same time a reliable means of detecting it. The group disease may be broken up but the influence of carriers cannot be measured if for no other reason than that they can seldom be detected under practical conditions even if the method be perfect. An animal, on being discovered a carrier, becomes a subject for isolation, treatment or sacrifice. Certain animals can be rendered safe in such diseases as the cutaneous ringworms, or in the cases of amoebiasis in monkeys by the use of emetine and nutmeg, but examples of this sort are rare. While one may disinfect the surroundings, the disinfection of the beast itself is a difficult matter.

I wish to return to the matter of group-disease or mass-disease. There is a difference of infective quality in a disease while acting as an epizoötic from its power when infecting single cases or small groups. This may in part be due to a facility for rapid spread that has been permitted by crowding as I have mentioned about quail disease, or it may be that, as in the experiments with mouse typhus by Amoss, the percentage of susceptibles enhances virulence and permits a larger number of chronic carriers to develop. While our experience has not amounted to controlled experimentation, it has been perfectly evident in cases of fowl cholera and psittacosis, that the epizoötic was shorter when susceptibles were segregated or separated by the removal of *all* birds from the house to a place out of doors.

There naturally enters into the matter of transmission of all infection, the attendant, the cage, the pans and similar objects, and the food. In experiments by Amoss referred to above it was found exceedingly difficult and, under ordinary practical conditions during an epizoötic, impossible to sterilize the hands and clothes of attendants. Under the workaday conditions of a zoological garden it is obviously no more likely that such an end could be reached. Our men are careful and seem desirous of avoiding transmission among their charges but there is no near approach to perfection. We assure ourselves of the absence of tuberculosis and other communicable diseases in the men by a medical examination of all applicants and a repetition of this at intervals in those keepers whose charges are especially susceptible to tuberculosis. The official personnel of the Garden attempt to teach the principles and practice of prevention by conversation and by office orders. The cage may

be a factor in infectious disease either by its location or construction. The former is relatively unimportant so long as sun and ventilation are afforded and the place is approximately suited to the beast. Rodents and owls prefer the dark and secluded places while the health of most birds is better in sunshiny open spaces. The construction of an enclosure is of the utmost importance in the development of disease and in the subsequent disinfection. It is customary to think that animals should be kept warm, and developments in building have all been in the direction of metal and concrete because of the ease of cleaning them. We have observed, and Doctor Mitchell of the London Society has expressed the same opinion, that with a few exceptions in the case of housing very delicate tropical specimens, it is not only unnecessary but unwise to heat exhibition houses and that animals easily endure quite cold weather provided they have a dry shelter in which they can huddle and where they can go in time of storm Doctor Mitchell even suggests that warmed enclosures increase death rate. The proof that such is the case or that cool houses preserve health is not easy to adduce. We are sure of one observation, however, in reference to monkeys—an Indian variety kept all winter in an open cage thrives and has huskier young than others which merely have access to the open to come and go as they wish, and they have had less tuberculosis.

The material of which an enclosure is made has a direct bearing upon the potentialities of disease transmission. It is obvious that earth and wood will afford more suitable hiding places for germs than will a hard cement floor and metal sides and that they can be less readily cleaned. However, I am decidedly of the opinion, by observations here and upon laboratory and domestic animals, that if wood and earth be kept free of germs, all varieties will be better in such enclosures than when surrounded by the heat-conducting metal and stone.

Disinfecting measures for earth take the form of turning over, to allow to lie fallow for an indefinite time, plus the application of lime, either as the simple oxide or as slacked lime. An asphalt flamer has also been used. The efficiency of such measures is probably high for diseases due to bacteria but against esophagostomum, hemonchus, heterakis, etc., can be but problematical. When these parasites become established it is the practice to place no new exhibit near or with the animals and to allow the land to lie fallow after their removal. Burning off the pasture with kerosene may also be effectual. Wood can be sterilized by disinfectants, the blast flame and by paint, when to any of these is added the liberal use of elbow grease. When any cage is vacated in the Gar-

den, it is scrubbed well and painted. In case of tuberculosis, mycosis, actinomycosis and similar persistent viruses, the blast flame is used whenever possible. If a serious outbreak has occurred in wooden enclosures these may be burned entire. Disinfectants may be used in small localities and for an isolated case but more reliance is placed on mechanical cleaning and paint.

The pans and other utensils are scrubbed and flamed, or, in the case of the bird house, are sterilized in a steam chamber. This is especially desirable because of the frequency with which pathogenic moulds occur in the bird's food.

The food of wild animals has to be adapted from the available kinds to the requirements of each variety as can be best done. This is accomplished for example by supplying certain ungulates with vegetables, others with grain, the appropriate feed being dictated by the alimentary tract construction. Some animals do not receive their natural food and do poorly in captivity (anteaters). The character of food offered, both in nature and quality, demands close control. The large carnivores are fed horse meat almost exclusively while the smaller varieties receive fowl heads and small rodents. The element of transmission of infectious disease is of some importance by this feeding. Careful inspection of the horses for glanders, before and after killing, has seemed to prevent this disease. Very few parasites of horses or fowls are known to be transmissable to carnivores. However, we had an outbreak in small mammals due to the paracolon bacillus, almost certainly acquired by eating the fowl heads from hotel kitchens; when the heads were boiled the disease disappeared. Loose hay, not baled, is bought for graminivorous beasts and soft alfalfa is fed to kangaroos that have a susceptibility to a disease similar to actinomycosis. The grain given to birds is passed through a blower to remove dust that might contain moulds. We are now working upon the subject of toxic grasses and plants on large ranges. The large number of rats that commonly infest such a place as a zoological garden must be quite a factor in the transmission of disease. Plimmer of London caught a large number and subjected them to postmortem, finding many disease states, including tuberculosis, blood parasites and visceral inflammations. Doctor Weidman has found at our Garden *Hepaticola hepatica* in the rat and in the prairie dog and has been able to transmit the worm from one to the other animal under controlled experimental conditions. These are surely evidences that the common rat is a menace to a menagerie. In the last two years we have been successful in reducing very materially our rat population

by the use of commercial "ratin" spread about the Garden on bread tied up in paper bags. Their depradations on our feed and woodwork are much less, this being visible evidence of their reduction. So far as known no other animal has developed rat plague; especially there has been no increase of mortality in our exhibition rodents.

Having discussed the general hygienic regulations we may now pass to a consideration of certain special measures designed to prevent the introduction of disease known to be frequent in certain arrivals. Forewarning of possible infection may be had from a history of the transportation and by the detection thereof at the autopsy table. This phase of work at the Laboratory of Comparative Pathology ranks in importance with the collection of data upon expressions of disease in various wild animal orders. The special hygienic measures directed against distemper have already been mentioned. They have been in force too short a time to have taught any special lesson but the reason for their adoption taught us the first lesson. A severe outbreak of distemper was started in the wild dogs (wolves, foxes, etc.) by the introduction into the row of pens of an apparently healthy European wolf, the beast being at the Garden five days before signs of infection were evident. This animal and fifteen others died from the disease. The infection must have been incubating on arrival. The water supply of the row of pens ran downward from the cage in which this beast was lodged; all the cases occurred downward from him.

Kangaroos frequently die from infection with a species of the genus *Nocardia*, which runs a course comparable to that of actinomycosis. It is said to be due to the penetration of the bacteria via wounds in the lips inflicted by sharp grain-beards. This theory is as acceptable here as it is for actinomycosis. Because of this, only soft alfalfa is fed, and to detect early cases all arrivals are inspected and the whole collection is examined at intervals.

Certain varieties of South American monkeys have come to us with amœbic dysentery, and many other kinds, including anthropoid apes, are known elsewhere to have been affected. All new arrivals of the varieties that have come to us infested and any other kind with loose stools are now examined by microscopy for the presence of amœbæ or cysts before the animals are passed to the exhibition cages.

These foregoing measures have resulted to some degree in protecting our collection but they are insignificant when compared with the very decided saving of the collection by the perfection of techniques to detect the proventricular worms of parrots and the existence of tuberculosis in

monkeys. These two procedures have saved so many specimens and so much money and at the same time have established so well the application of prevention that they deserve special consideration from hygienists. I shall describe each separately, giving the technique and the results together.

Certain parrots, especially old world varieties, were at one time heavily infested with a small nematode inhabiting the lumen and mucosa of the proventricle and gizzard, there producing a collection of mucus and a swelling of the lining of the tube to an extent obstructing the lumen. This infestation caused a high and constant mortality ranging from six to sixty per cent and costing in the neighborhood of two hundred dollars annually. The worm was studied and identified by Dr. A. J. Smith as *Spiroptera incerta*, and its life history, transmission and detection were investigated by Doctor Weidman. Our knowledge of the first and second remains imperfect but the method of discovery of the presence of the worm was accomplished. This is done by starving the bird for 12 to 24 hours, depending upon its size, and examining the droppings after boiling them in caustic soda. The eggs are readily found and recognized. This technique having been established, the parrot house was emptied, cleaned, all parrots examined and only non-infected specimens returned. The infested birds were separated for experiments on transmission and treatment; these unfortunately were fruitless. The mortality quoted above stopped abruptly so that from 1913 for seven years, during which time all new arrivals were examined before exhibition, no case of parrot spiropteriasis occurred in the house. In 1921–22 several new cases arrived and two occurred in parrots but apparently it was an imported and sporadic affair and the species of worms seems slightly different. The cleaning of the house, with the removal of all sand, in which larvation occurs, and the painting of cages seem to have eradicated the focus. Medication has not been found at all efficacious. The preservation of birds has been of great importance in the maintenance of the collection while the possible saving of fourteen hundred dollars during the seven entirely free years is worth the effort of the work.

Tuberculosis affects practically every variety of animal, but the monkey, or rather the order Primates, has the lowest resistance to the disease among the mammals. The high mortality among these animals, the absence of signs of resistance as indicated by healed and fibroid lesions, and the frequency of tuberculous caseous pneumonia, are sufficient evidences that no immunity is possessed by their tissues. There is no

satisfactory evidence that tuberculosis occurs in the wild state although there are some reports that tuberculous monkeys have been received in laboratories directly from their habitat. It seems probable that this may be explained by the rapid development of the disease contracted immediately after capture so that it appeared advanced when examined, or it is possible that the monkeys have visited around the native villages and been exposed in this way, visiting monkeys being the most easily caught. However this may be, the disease in them is a progressive destructive affair, and suggestive of the fact that it has only recently been introduced among them. They have not had time in their history to develop immunity, and succumb the more readily just as the American Indian did when he first encountered the tubercle bacillus. Then too they are huddling creatures and the disease may assume the character of a mass-disease. The ease with which transmission can take place needs no commentary for anyone who has watched monkeys at play or at struggle when they indulge in physical conduct well designed for a generous distribution of a contagium vivum.

Tuberculosis has always been a scourge of zoological collections, being especially common in monkeys, bovines, deer, doves, and ground birds. The value and interest of all collections of monkeys make their loss quite serious so that the eradication of the disease is highly desirable. The detection of the disease cannot be made accurately by physical examination, even where this is practicable, so that some means of certain diagnosis is needed. Actuated by a desire to discover such means, Doctor Penrose and some associates began in 1903 the study of the tuberculin test, and during the next three years succeeded in developing a method whereby the reaction of a tuberculous and a healthy monkey was well understood. The normal monkey will not change his ordinary health or temperature after a subcutaneous test dose of tuberculin whereas a tuberculous monkey will have a definite temperature reaction and may show an advance of his disease sufficient to give symptoms or even to hasten his end. It may be interesting to note here that a monkey has not a regular and uniform temperature level during twenty-four hours but the records performed a V-shaped course with the high point around 102°F at 3 p.m. and the low point near 100°F at 3 a.m. This information is necessary before judgment as to a febrile reaction in monkeys can be reached.

Having established this technique the monkey house was emptied, fumigated, washed, painted and filled only with non-reacting monkeys, that is healthy monkeys. Quarantine and hygienic regulations were

established by having separate utensils for healthy and supicious monkeys, refuse was carefully removed and burned and hay was avoided when the animals could do without it.

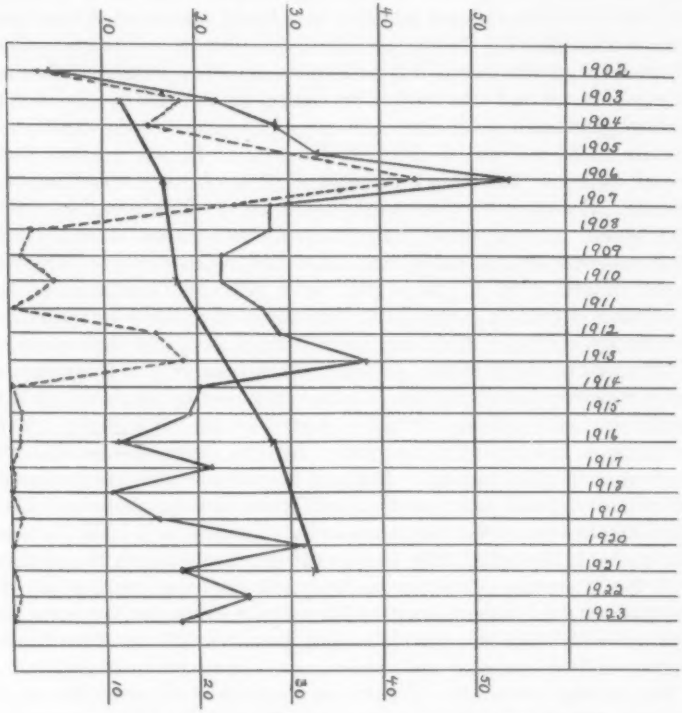

CHART SHOWING THE MORTALITY OF MONKEYS 1902 TO 1923

The solid line is total mortality, the dash line the deaths from tuberculosis. The proportion is easily perceived to decline after the perfection of the test in 1906. The rise in 1912–13 was due to an accident as explained in text. The exhibition time in months, indicated by the heavy line, rises uninterruptedly as tuberculosis comes under control.

The result of this test has been most striking. We have discovered tuberculosis in 23 per cent of all tested monkeys but the percentage coming to us in former years was much greater than this, the figures

being reduced by the receipt of a better grade of specimens in recent years. In the years before the test was well under way, that is, prior to 1903, 76 per cent of the monkey mortality was from tuberculosis. During the trial years 1903–6 when many monkeys were being used for experiment and many were probably too closely associated, 85 per cent were found affected. In the next five years—to 1911—the proportion of deaths from the disease fell to 27 per cent. Immediately following this period we had the mishap of letting an infected specimen slip through, causing a small cage outbreak which increased the death proportion to 34 per cent in the next five years. During the four year period ending in 1921 only 6 per cent of all monkeys received had the disease. However this does not represent the death rate in the exhibition house. At the present time two years have elapsed since a death from tuberculosis occurred in that house and there have been only two cases altogether in 8 years. We have never underestimated the possibility of missing a very early case nor of the chance infection by feeding by visitors. However, there can be no doubt that whereas tuberculosis formerly carried off nearly all the monkeys, it is now not a menace so long as we continue to admit only healthy specimens to the exhibition house. Every animal is tested on arrival and the whole collection is tested every two years; by this latter means we discovered an infected monkey. Not only has the mortality been reduced but with it naturally an increase of exhibition time has occurred. Before 1903 the average exhibition time was 11 months; from 1903–6 it was 15 months; in the period 1906–11 it was 16 months; 1911–16, 27 months; 1916–20, 31 months; these figures are based upon the length of life of animals now dead from all causes. There are on exhibition at present 88 monkeys with exhibition periods ranging from 1 to 197 months with an average of 54 months.

The average annual loss of monkeys for each of the periods quoted above was 13, 28, 5, and 5, a total of 192. Valuing these beasts at $50 per head, the financial loss was $9600. The saving of monkeys from the eradication of tuberculosis is obvious. Against this might be charged the cost of the test but health and the reduction of mortality is a credit and asset, not a debit charge. Moreover all these years of experiment, trial and effort have resulted in establishing a system and a healthy exhibition house into which the directors have put the finest exhibition of the order Primates now to be found in the world. The experience establishes without doubt that tuberculosis can be eradicated from the most susceptible of animals and that a healthy

group will remain free of disease so long as no tuberculous individual is introduced. It also teaches that the unsuspected case, the one most difficult to detect, is the one toward which our major efforts should be directed. It has formed one of the most satisfactory and completed instances of laboratory medicine and practical hygiene on record. If so much can be done for the highly susceptible but not coöperative monkey, how much more might be done for the somewhat resistant and intelligent human being.

Another interesting experience concerns the exhibition of a group of rhesus macaques in an open "bandstand" cage. The idea arose in an attempt to find a separate exhibition cage for some good specimens that gave unsatisfactory charts, with the purpose of applying at the same time the "open air" treatment if tuberculosis existed. The experiment has been entirely successful since, in the eleven years during which this enclosure has been used, there has been but a single case of tuberculosis among twenty-six monkeys. Curiously enough this exception gave a good chart and we suspect it was a visitor infection; no secondary case arose from it. The animals housed in this cage keep in excellent condition, their coats responding to our severe winter by increasing in thickness and glossiness. Frozen toes, fingers and tails are sometimes seen but these monkeys seem just as happy as the others. Breeding is active and the young are lusty and husky. Practically the only deaths are due to accident, or to abuse of old and less vigorous members of the colony. We are unable to give comparative exhibition periods and death rates for monkeys in the large house and this open cage because some specimens have been changed from one to the other but it is certain that the appearance of the "bandstand" monkeys is better than those in the house and there are four of eleven animals in the former which have been there eleven years and only four among the seventy in the exhibition house for this length of time.

The health-stimulating influence of our out-of-door life just illustrated by monkeys is not found in all specimens because some varieties like deer do not evince any special resistance to the disease. It is interesting and perhaps significant that the animal nearest to man has found open air life healthful.

One of the most interesting and instructive results of our work has been the observation of the development of infectious disease along lines of susceptibility. Tuberculosis among the birds offers a clear demonstration of this influence although the low resistance of South American parrots to certain forms of avian typhoid and to worms, and the preva-

lence of enterohepatitis in gallinaceous birds might also afford illustrations. However, a study of the incidence of tuberculosis in the New Bird House by means of a pin-spot map gives details of value for origin of infection and the relation of housing to it.

Tuberculosis has the highest incidence among birds of the orders Columbæ and Galli, these being followed at some distance by the Passeres, Psittaci, and Fulicariæ. The northwest corner of the bird house has been occupied for several years by members of the second order, Galli. Tuberculosis has been constant among them, has spread laterally to cages occupied by susceptible varieties, and remains constant as the exhibition remains. If other cages in the house become affected it is found that the affected birds usually belong to groups of high susceptibility but spread occurs only when susceptible material is available. Almost without exception if the cage be cleaned after one of these isolated cases the disease disappears or, when the susceptibles die off or are removed, the cage remains clean. Not so when the susceptible material is concentrated, for despite separation of the birds and thorough disinfection of the cage, the disease reappears with the return of the same varieties. And it is perhaps well to keep the disease sequestered in this corner.

The large flying cage contains about ten zoological orders of birds, which have numbered 161 in the last 4½ years. Of these 12 have died of tuberculosis, six being of the especially susceptible varieties, three of somewhat susceptible kinds and the remaining three being scattered species less often tuberculous. Here again one can see the effect of susceptibility, for surely the opportunity of wide spread contagion is present. The roominess and lightness of the cage, the facility of greater exercise and escape from sick companions may have some effect but the general principle is not destroyed.

This is the outline of the hygienic measures practiced at the Philadelphia Zoological Garden. It shows clearly the duty of hygiene in a collection of animals whose fate can be controlled but whose condition can only be known approximately and whose coöperation cannot be had. Despite this, hygienic measures have succeeded in controlling several disease states, especially when supported by a careful pathological study of the specimen, to which is added survey of the various infections as they occur during life.

Zoological Society of Philadelphia.

RODENT ENEMIES OF FRUIT AND SHADE TREES

By James Silver

It is not possible to draw a definite line between rodents that may be classed as actual enemies of fruit and shade trees and those that are injurious only under certain unusual conditions. Possibly all rodents damage trees to some extent, if only by eating an occasional seed. Seventeen kinds of rodents may be specifically selected as potential enemies of fruit and shade trees, of which at least five may be considered to be really serious.

Rodent enemies of trees may be divided into two classes, the bark eaters and the seed eaters. The bark eaters may be held to include ten groups of rodents, as follows:

Meadow mice.
Pine mice.
Pocket gophers.
Rabbits.
Hares.
Mountain beavers.
Wood rats.
Woodchucks.
Porcupines.
Beavers.

The seed eaters fall into seven groups, as follows:

Tree squirrels.
Flying squirrels.
Ground squirrels.
Chipmunks.
White-footed mice.
Roof rats.
Cotton rats.

The five rodents that for the purpose of this paper have been selected as serious enemies of fruit and shade trees are all bark eaters. Listed in the possible order of their importance these are the meadow mice, pine mice, pocket gophers, rabbits, and hares. The total annual injury in the United States by each species has been considered in arranging them in this order rather than the propensity of individuals for injury.

While the meadow mouse has been placed before the pine mouse, individually it is less a menace in orchards, but because of its great abundance and wide distribution it probably surpasses the pine mouse in total injury. The injury by the mountain beaver, for instance, is insignificant at present, due entirely to the limited range of this animal and to its relative scarcity, although individually or locally its destructive tendencies might put it at the head of the list. Other rodents, such as the beaver and the porcupine, might cause considerable injury to forest trees, but, by reason of their natural environment, they come but little in contact with fruit and shade trees. Rodents injuring forest

trees, however, must also be considered potential enemies of fruit and shade trees. Shade trees in this paper mean trees planted by man for shade or ornamental purposes.

SEED EATERS

The seed eaters, although relatively unimportant, become at times serious pests. The economic status of several seed-eating rodents, particularly the squirrels, has given rise to much controversy with little hope of gaining definite and satisfactory conclusions. Without trying to ascertain, however, whether or not the genera as a whole are beneficial or injurious, there can be no doubt that at times squirrels become exceedingly destructive, and under such conditions should be controlled. Tree squirrels and flying squirrels gather and store great quantities of nuts. If these nuts are gathered from pine or hickory trees from some deep wood, the habit is of little consequence one way or another. On the other hand, should they be paper-shelled pecans, from a highly cultivated grove, the matter becomes entirely different.

Squirrels once established in the vicinity of a nut grove are difficult to dislodge, and considerable loss results, as is often reported by pecan growers of Texas, Georgia, and Florida and by walnut growers of California. Fruits are also commonly destroyed by squirrels in their quest for the fruit seeds. In addition to these well-known thieving habits, squirrels sometimes severely injure trees by barking and girdling them. Maples are perhaps the ones most often attacked. The point of injury is usually around the larger limbs, where the damage is frequently severe enough to cause the death of the tree. Chestnut trees also seem attractive to the squirrels, and a great variety of both deciduous and coniferous trees are injured. Leo K. Couch, in charge of the Biological Survey's rodent control operations in Washington State, has reported that the activities of tree squirrels in girdling fir and pine trees were more pronounced in the spring of 1923 than in 1922 and that in certain places on the prairie as many as half the trees could be counted as girdled or partly so. Opinions of eleven forest supervisors of Colorado and Wyoming on the status of squirrels in relation to the forests expressed in response to a questionnaire, were as follows: Three considered them beneficial, chiefly on account of their large stores of select seeds, which are a great aid to the Forest Service in gathering the seed; three stated the belief that the squirrels actually help reforestation by distribution of seed; while, strange to say, only one mentioned their esthetic value.

White-footed mice, chipmunks, and side-striped, thirteen-lined, and

some of the other ground squirrels, while ordinarily quite harmless, are very destructive wherever reseeding is attempted. Dr. Ned Dearborn observed a chipmunk visiting 38 seed spots in four minutes in an experimental plot in the Black Hills, South Dakota, that was damaged 70 per cent in three days by chipmunks and deer mice. R. T. Jackson, also of the Biological Survey, found that deer mice destroyed from 10 to 90 per cent of the seed planted by the Forest Service on the Ocala Division of the Florida National Forest. Through their fondness for cherry pits, chipmunks are a decided pest to the cherry growers of the Bitter Root Valley, Montana.

Roof rats are very abundant in Florida, and although having much the same characteristics and food habits as the brown rat, they are more at home in trees and have a greater appetite for fruit. Damage to citrus fruits is prevalent, although the injury is rarely serious. One large grower of mangoes and avocados near Miami found it necessary to place metal protectors about the trees in order to save the fruit. Roof rats eat both the seeds and the pulp of fruit. Some fruit is found with just a small hole cut through to the seeds, while in others only the hollow rind is left.

There is a question as to whether the cotton rat should be accused of being injurious to trees, as it is distinctly a field rat. An occasional complaint of its injury to trees or fruit, however, seems sufficient evidence to warrant rating it a possible enemy. David G. Fairchild, of Tempe, Arizona, reports that a great deal of trouble was recently experienced with rats in date plantations, and that these rodents had in fact stolen over half the crop of dates which ripened on the tree. The rats were identified as cotton rats (genus *Sigmodon*). In Florida also this rat is accused of gnawing off young and tender branches of fruit trees as well as of destroying the fruit on and near the ground.

BARK EATERS

Passing to the more injurious rodents, the bark eaters, the less important may first be briefly considered. Beavers do not often come in contact with cultivated trees, but at times subject themselves to severe criticism by cutting those valuable for shade and fruit. Injury from beavers is due more to flooding caused by unfortunate placement of their dams than from their habit of cutting trees. Beavers introduced into the Adirondack Mountains, New York, became very troublesome several years ago. Theodore H. Scheffer, of the Biological Survey, in a recent report states that beavers protected in the State of Washington for

several years have become an intolerable nuisance in some localities, and that by damming streams they flood valuable meadows, cut orchard and shade trees, even in the farmers' door yards, and divert water courses by tunneling the creek banks, to say nothing of romping in the grain fields and wallowing in the alfalfa.

Porcupines also are far more injurious to forests, where they feed on the bark of both conifers and deciduous trees, than they are to orchard or shade trees, although they often damage plantations adjoining wooded areas. The supervisors of national forests in Colorado and Wyoming, in further response to the questionnaire referred to above, expressed opinions relative to the economic status of porcupines on their respective forests. Of 15 answers received, three foresters believed the porcupines should be spared as an emergency food supply, while 12 were of the opinion that because of their destructiveness to trees they should be exterminated. The State of Maine once appropriated $1,000 for a 2-year period to pay a bounty on porcupines; the result was a deficit of $20,000. I. N. Gabrielson, of the Biological Survey, reports that about one-third of the second growth in certain districts of Jackson County, Oregon, is destroyed by porcupines.

Woodchucks, or marmots, are not ordinarily thought of as being destructive to trees, yet there has been considerable complaint of their depredations on orchard trees throughout New England. The injury may be accomplished in several ways, but the most common is in badly chewed and clawed bark. The woodchuck will often climb into the lower crotch of a fruit tree and lie there sunning himself, idly scratching and gnawing the bark. Many trees, usually between the ages of 3 and 7 years, are girdled and killed in this manner. Another common form of injury is caused by woodchucks burrowing directly beneath the trees. This allows increased drainage and aeration of the roots, sometimes with disastrous effect. Woodchucks are also fond of the ripe fruit but as most of this is procured from the ground, this form of injury is inconsequential.

A case of considerable injury to reforestation by wood rats, or pack rats, on the Angeles National Forest, of California, is reported by the late A. F. Taylor, and Edw. N. Munns. Mr. Taylor reported the food of the wood rat to consist chiefly of the leaves, buds, bark, fresh roots, and fruits of the large chaparral. Mr. Munns found on an experimental plot of one-fifth of an acre, on which 9 wood rats were nesting, that 23 per cent of pine trees were killed, as a result of girdling, 19 per cent were severely injured, 15 per cent slightly injured, and that 41 per cent were

not harmed by these animals. The bark of the girdled trees had been almost entirely removed from the ground line to near the top, or to that point where the needles persist. These needles seem to act as a deterrent to further girdling. The trees ranged in height from 1 to 10 feet.

Mountain beavers occur only along the west coast ranges, from San Francisco north into British Columbia. Although their food consists largely of grasses, ferns, and tuberous roots, they are also very fond of the terminal twigs and smaller branches of trees. In winter, under the cover of snow, they often destroy by girdling large trees 2 feet or more in diameter, particularly fir and maple. The menace of mountain beavers to strictly fruit and shade trees increases with the encroachment of farmers into the domain of these queer little animals.

SERIOUS ENEMIES OF FRUIT AND SHADE TREES

Hares and rabbits, pocket gophers, and field mice are considered serious enemies of fruit and shade trees because of the sum total of their depredations on these trees, so that their abundance and wide distribution have much to do with this classification. Hares and rabbits, including the white-tailed and the black-tailed jack rabbits, the snowshoe rabbit, the European hare (now firmly established in New York, New Jersey, and adjoining states), and the cottontail, all include the bark of trees in their diet and during severe winters and drought in summer they often cause serious injury by girdling young trees. Complaints of orchardists, particulary nurserymen, are constantly heard from all sections of the United States. Practically all varieties of deciduous and citrus-fruit trees are damaged by rabbits. On a planting of 25 acres of young catalpa trees in Pennsylvania over 12,000 were destroyed the first winter by cottontail rabbits. In Dutchess County, New York, during the winters of 1911 to 1916, it was estimated that young fruit trees with a valuation of over $100,000 were destroyed by European hares. Over much of the sage-brush areas of the West, orchard and shade trees are at a premium and are constantly menaced by jack rabbits during severe winter weather. The extent of the menace varies with the abundance of the animals from year to year and in years of greatest abundance, as in 1915, in Harney County, Oregon, when bounties were paid on nearly 1,000,000 jack rabbits, the danger of severe injury is acute.

Pocket gophers subsist largely on roots of various plants and are a greater menace to trees, both singly and collectively, than are rabbits. Fortunately their range, although wide, is less extensive. They come

in less frequent contact with trees and are more easily destroyed. Pocket gophers always advertise their whereabouts by the conspicuous mounds they throw up, and the presence of these mounds near valuable trees is usually sufficient incentive to start a war of extermination. The underground habit of pocket gophers renders them difficult to reach, but this is more than offset by the fact that if one attempt to destroy them fails they may always be found at or near the same place for the second attempt.

The injury by pocket gophers to trees is always below the surface of the ground, where the smaller roots are usually severed and the bark is removed from the larger roots. The pocket gopher damages nearly all kinds of the more common fruit and shade trees, from the tender bark of a young apple to the tough, hard roots of the osage orange. Many reports are received that would indicate marked discrimination, but others contradict them, so that it is probable that factors other than palatibility often account for the apparent discrimination. One nurseryman of North Platte, Nebraska, says that pocket gophers cut off about 25 per cent of the silver maples during the first winter after they were planted, and destroyed nearly all of the honey locusts in one plat, repeating the operation when these were replanted; but that only a very few trees of other varieties were injured.

D. E. Lantz quotes Dr. A. K. Fisher as observing that roots of fig trees seemed most subject to the attack of pocket gophers in southern California, with apricot next in favor, while damage was also done to orange, lemon, almond, apple, pear, and other orchard trees of this region, except the peach. Other correspondents also noted that the peach was not molested, but one investigator in Oregon found large stores of peach, apple, and walnut roots in pocket gopher workings; Lantz states also that peach trees are often damaged severely in the Mississippi Valley. A Kansas writer complains of severe injury to cherry and pear trees, and also reports a number of poplar trees destroyed. One nurseryman finds that young elms are favored, while R. T. Jackson, of the Biological Survey, found pocket-gopher stores on the Nebraska Forest to consist largely of roots of the wild rose. A resident of Louisiana reports the loss of dogwoods and jasmine vines, while a common complaint from Florida and other southern states is of injury to pecan trees by pocket gophers, or "salamanders," as they are called in the South.

Citrus fruits also come in for their share of injury, as testified by D. A. Gilchrist, who states that the citrus growers of Phoenix, Arizona, have saved thousands of dollars worth of trees by cooperating in a Biological

Survey organized campaign against pocket gophers. E. E. Horn, of the Biological Survey, reports a case of unusually severe injury; he viewed the remains of a 40-acre block of cherry trees so badly damaged that not one tree in the entire area remained sound. This block was part of a large orchard of 5,000 acres, of which about 180 acres, or 9,000 trees, were totally destroyed by pocket gophers. Forest trees are also badly injured at times, the most severe case on record being on the Nebraska National Forest, where the Biological Survey has cooperated with the Forest Service in poisoning campaigns. It was found that approximately 10 per cent of the increased planting each year is killed by pocket gophers. On the 6,000 acres about 120,000 trees were killed.

There could be nothing more discouraging to a fruit grower who cares for and who has perhaps raised his trees to the point of profitable bearing than to see them destroyed by mice. Yet every year many thousands of valuable trees throughout the United States are killed by these pests. Much of the injury might have been avoided through the use of proper preventive measures, but unfortunately the irregularity of mouse trouble leads to carelessness on the part of the tree grower. Following a season of unusually severe mouse injury, commonly referred to among orchardists as a "mouse year," elaborate precautions are usually taken to prevent further damage, but with the passing of several uneventful seasons vigilance relaxes and conditions favorable to mice again prevail. Such practice is well suited to the propagation of mice, as usually a great scarcity of these rodents follows closely on the heels of maximum abundance, so that often the orchardist is employing preventive measures when there is no need and becomes careless just as the mice are marshaling their forces for another attack. An abundance of mice in an orchard, of course, constitutes a greater menace than a lesser number, although in mild, open seasons there may be no injury in a heavily infested orchard while a comparatively few mice may prove extremely destructive during the course of a severe winter with lots of snow. Dry spells during the summer or late in the fall may precipitate mouse injury to trees, while occasionally severe depredations occur for no assignable reason whatever.

Field-mouse injury to trees is greater in the northern states than in the South, largely due probably to the longer dormant season without green foods; and perhaps partially due to the deep snows which furnish excellent cover, beneath which the mice may work in cultivated areas in comparative safety.

Of the two common forms of short-tailed field mice, the meadow mouse

and the pine mouse, the latter is individually more inclined to attack trees. A larger proportion of its food consists of various roots, bulbs, and tubers; and tree roots and bark no doubt form a part of it; although probably only during a scarcity of more favored foods does it attack trees seriously. The pine mouse, on account of its underground existence, damages trees almost wholly below the surface, so that the injuries go unnoticed until the wilting tree betrays its wounds. The injury also often extends too far down on the roots to allow bridge grafting, so that the tree may be irretrievably injured. The meadow mouse, on the other hand, girdles the tree from the ground to a height of perhaps six inches, a damage which is usually apparent as soon as the snow melts, so that trees so injured may usually be saved by bridge grafting. Meadow mice, however, are far more prolific breeders and there is always the possibility that, under conditions exceptionally favorable to their increase, they may reach plaguelike proportions and devour every edible thing in sight so suddenly as to find fruit growers totally unprepared. Serious mouse plagues have not been numerous in this country, however, so that the pine mouse is easily the more dangerous enemy of fruit and shade trees, and only the wide distribution of the meadow mouse is responsible for its heading the list of rodent enemies of these trees.

The list of fruit trees injured by mice will certainly include a large percentage of the whole. The fruit tree sustaining the least injury is probably the cherry, although there are cases on record of injury to this tree also. Citrus fruits are damaged less severely but it is no doubt because of their being associated with a perpetual supply of green feed for mice. An occasional report of severe injury to citrus fruit trees is received, however, such as in one case in California where over 1,300 orange trees in one grove were killed. Many kinds of forest trees are also among those injured, including both conifers and deciduous, and hard and soft woods. Field mice in attacking trees show a surprising lack of discrimination in their selection of variety. Observations indicate that, with few exceptions, they attack the tree nearest at hand when a scarcity of more desirable food overtakes them. They do show, however, a decided preference for the more succulent bark of younger trees, although records are on file of their killing trees of all ages. Pine mice, working on the roots, are more apt to injure the older trees than are meadow mice, which must penetrate the rough, hardened outer bark to get at the edible inner bark and cambium but they will not hesitate to do this under the urge of hunger.

Fruit and shade tree losses in the United States from field mice amount to several million dollars annually. There are records of such losses amounting to $10,000 on a single farm and to $100,000 in a single county, while a loss of $500,000 is the estimated loss to fruit trees in the State of Connecticut alone during a recent "mouse year." When a well-known mammalogist found no justification for the destruction of meadow mice it is evident that he had a different point of view from that of the Maine pomologist who found that, with the possible exception of winter killing, meadow mice were the greatest cause of mortality among young fruit trees of the state.

Biological Survey, Washington, D. C.

THREATENED EXTINCTION OF THE WHITE RHINOCEROS (CERATOTHERIUM SIMUM)

By Herbert Lang

The widespread indignation caused a few years ago by the tragic slaughter in South Africa of the Addo Bush elephants appears to have taught the local farmer elements a lesson in cunning deception. The disquieting reports about the present status of the square-lipped or white rhinoceros in the Umfolosi Reserve in Zululand show how successful these men have been in their unwise efforts to wipe out one of the most important remnants of the unique Ethiopian fauna.

Instead of starting an open campaign to enlist public support and fighting for legal sanction they took care not to herald their intentions. Even the South African champions of game protection have been taken entirely unawares by recent developments, as it appears from extracts from correspondence just published by Dr. W. T. Hornaday (p. 13).

We are far more justified in becoming alarmed than at any time previous. The only South African square-lipped rhinoceroses still alive are roaming about in a 90,000 acre reserve, for the greater part situated between the Black and White Umfolosi Rivers in Zululand. Their habits and the conditions under which they are living were admirably described in 1920 by Vaughan-Kirby. The Natal administration had given assurances of keeping this sanctuary free from disturbance. From time to time there have been encouraging rumors of the increase of these square-lipped rhinoceroses. The original colony of ten was said to have multiplied to thirty or even fifty. Everything seemed

to point toward their having gained a new foothold, and there was hope that they might be able to recover under proper protective measures in the same degree as the American buffalo, but events lately have taken a tragic turn. Maj. J. Stevenson-Hamilton, warden of Government Game Reserves, Province of Transvaal, now places the number of these rhinoceroses at sixteen or less.

In a recent article (Lang, 1923, p. 155) I pointed out that permission for collecting two specimens had evidently been extended to representatives of the Cape Town Museum, and Henry A. Snow also received a permit to kill three specimens for the Oakland Museum of California, but according to Hornaday (p. 12) slaughtered four. At least two more have been unlawfully shot by a young man who was fined the ridiculously low sum of £25.

In addition some of the neighboring farmers have been making a point of sniping off the few surviving South African rhinoceroses in order to grab for their own purposes the land set aside for these remaining troops. They wage this war of extermination merely in the greedy hope that as soon as they are able to "finish the lot" they can transform into ranches some of the land of the reserve. From their point of view it is monstrous that a few "brutes" should be given preference in a stretch of land of which they covet some parts. For some time past there has been going on in large areas in Zululand "wholesale and indiscriminate slaughter of the game animals" (Haagner, p. xviii). In these raids (Buxton, p. 281) an organized band destroyed over 3,000 head of large game, leaving an unknown number of wounded to die. Not even the small remnant of white rhinoceroses, which Buxton estimated at ten at most, was spared.

In contradiction to the above statements about the immediate extinction of the white rhinoceros are the remarks of Mr. Wynant Davis Hubbard (p. 229) in his recent article on 'Big Game in Rhodesia.' He writes from Tara, Northern Rhodesia, a station on the railroad at about 16° 50′ S., 26° 45′ E. Until there is definite confirmation of his statements we must feel he is mistaken in saying that "there are quite a few [square-lipped rhinoceroses] at present living not far from here [Tara] I know. Just how many there are it is impossible to say. In comparison with the black rhinoceros the white is not uncommon in certain places. In others, however, it is totally lacking."

If he could actually prove the occurrence of the square-lipped rhinoceros in that region, Mr. Hubbard would make a great contribution to our knowledge about its present range. Fitzsimons (vol. III, p. 207)

indeed states that "it is possible one or two may still exist in the remoter parts of Southern Rhodesia." But not one of the well-known South African champions of big game or writers on this subject, like Stevenson-Hamilton, A. K. Haagner, Vaughan-Kirby, or Heller have ever indicated the presence of white rhinoceros in *Northern* Rhodesia, although the parts east of the Zambesi, that is, Southern Rhodesia, were formerly its favorite haunts (Vaughan-Kirby, p. 224). In fact, as my maps of distribution of this form clearly show (Lang, 1920, p. 77; 1923, p. 156), there is no authentic record that the southern square-lipped rhinoceros (*Ceratotherium s. simum*) ever occurred within the memory of man further north than the southern bank of the Zambesi—while Tara lies 60 miles northwest of that river and about 750 miles from the Umfolosi Reserve—and the northern form has never been known south of the northern end of Lake Albert.

The reports by Speke and Grant of the white rhinoceros in Uganda rest clearly upon misidentification, as shown by Heller (p. 36) and others. Heller stated (p. 39) that there "is no evidence, geological or otherwise, to show when this intermediate territory lost its square-nosed rhinoceroses." Since then Reck (p. 308) has provisionally referred the fossil remains of a rhinoceros from the Pleistocene of Oldoway, at the eastern Serengeti Plateau, Tanganyika Territory, to *Ceratotherium simum* (= *Rhinoceros simus*). This has later been cited by others (Schwarz, p. 848), but it remains to be seen whether subsequent study of this material will positively establish this record for *C. simum*. That the species must have lived in North Africa contemporaneously with man I have shown lately (Lang, 1923, p. 159); also that *C. s. mauritanicum* was common in the Algerian Pleistocene (Lang, 1923, p. 161).

Coincident with the disturbing news from South Africa about the Zululand square-lipped rhinoceros, Dr. Cuthbert Christy writes (p. 63) of an equally hopeless condition as regards the protection of the West Nile, or northern, race (*C. s. cottoni*). It is apparent that as a result of the World War the natives have become less heedful of the existing laws for game protection, which, like most such African ordinances, can only be enforced when adequate power is provided to carry them into effect. There are confiscations and fines where tax stations are maintained, but often tricky traders escape even this by smuggling.

Christy states that the "small region in the Congo in which the animal is commonest is almost uninhabited." I happened to spend nearly three years in that section of the Belgian Congo and found the natives

fairly numerous, much more so than just across the border in the Sudan. Travelers on the main roads, however, would meet few natives, who in order to avoid trouble place their villages out of reach of caravan traffic. But in this vast country there ought to be ample room for both natives and rhinoceroses.

The square-lipped form in the Belgian Congo occurs from a little north of Lake Albert all along the eastern border of the Belgian Congo to the Sudan and westward over a stretch of about 520 miles across the Uele district to the Bomu River. Its essentially nocturnal habits and the high grass savannah ordinarily protect it from view except when deliberately followed up or accidentally run across during its daytime sleep. Such excellent naturalists as Emin Pasha and Schweinfurth traveled extensively in these regions and never reported its presence.

There is little fear of the destruction of these rhinoceroses by natives armed with spears, as Christy supposes; the danger lies in gun and powder of which there is always an abundance, of either lawful or smuggled provenance. The few Azande hunters, justly famed among the tribes for dangerous exploits, are admired as much for killing a rhinoceros with a spear as an elephant or buffalo, which are acknowledged dangerous game. Anyone can understand that the spear, thrown only at close quarters, will not instantly despatch but only infuriate such huge monsters, no matter how tame they are otherwise. These rhinoceroses are of course attacked when sleeping. On such occasions they are but seldom alone,—two, three, or more generally resting in the same place. In the ensuing tussle the frightened comrades are just as apt to charge towards the hunter as into the jungle. This is exactly what happened to an Austrian hunter named Fleischer, who boasted he could lay his hand on any rhinoceros before it would even be aware of his presence. He shot a female rhinoceros and, just as he approached the prostrate animal, the male charged over the dead body and with the tip of its horn grazed his forehead above the eye. He was carried away unconscious by his porters and much to everyone's surprise was up and around a while afterward. But he really never recovered and soon after succumbed at Khartum as a result of this adventure.

There seems to be no effective means at present of stopping the wholesale slaughter of this northern form. Its meat is one of the important parts of the native diet, procurable at all times without much difficulty. Even though the principal chiefs were willing to enforce protection there would still be a great number of native poachers and such a law would

never be adequately respected. To properly police these vast areas is practically impossible.

The situation would be helped in part by the more drastic enforcement as regards confiscations and fines for the transportation, sale and exportation of the horns and pieces of hide. Khartum is a great center at present for the exportation of horns to the Orient and for the manufacture therefrom of articles sought alike by sportsmen and curio collectors. What complicates matters is that the horns and hide of the black rhinoceros, so common to the south of Khartum and on the east bank of the Nile, are lawful articles of trade. There are no positive marks to distinguish the horns of the two kinds of rhinoceroses, except that on the whole the horns of the square-lipped form are heavier and the anterior horn has a squarish base and more flattened front.

How the coöperation of the Ubangi-Shari officials, advocated by Christy, would help I fail to see as the traffic in white rhinoceros trophies does not go in that direction. No square-lipped rhinoceros is known from the Ubangi-Shari region. From that section authentic data are only available of the occurrence of the black rhinoceros (*Diceros bicornis*), which Nachtigal in 1872 found was as common there as in Wadai. It occurs in numbers again on the eastern bank of the Nile (Heller, p. 38), although it has never been observed in the northern range of the square-lipped rhinoceros.

To return to the problem in South Africa, a monumental issue is at stake. Historically it is of interest to consider the great abundance of the square-lipped rhinoceros at the time when, in 1817, Burchell gave the first account of them. It makes the blood boil to read how some famous game butchers "during one short hunting trip, killed ninety Rhinoceroses, the majority of which were of the square-lipped species. Another hunter killed sixty in a single season" (Fitzsimons, III, p. 209).

The officially organized killing of the Addo Bush elephants in 1919 was bad enough. Under Major Pretorius' leadership the members of the last vigorous herds of the fast disappearing South African elephant (*Loxodonta africana capensis*) were hunted down and mercilessly shot. In that case world-wide appeals managed to save from destruction but the few which fortunately had escaped the initial stages of the slaughter —sixteen from a herd of one hundred (Osborn, 1921, p. 244).

Fighting against tremendous odds, the South African game protectionists achieved a success in the last few years that offers encouragement in the present desperate case of the square-lipped rhinoceros. By tireless efforts these crusaders aroused more than mere interest and

sentiment. The enrollment of the government officials concerned, the winning over of so many bitter antagonists, and foremost of all the practical results are good signs. Through their efficient efforts many small troops of such game as mountain zebra (*Hippotigris zebra*), blesbok (*Damaliscus albifrons*), bontebuck (*Damaliscus pygargus*), and white-tailed gnu (*Connochætes gnou*) have been given a new lease on life. So long as Doctor Haagner, Major Stevenson-Hamilton, and Colonel Reitz, the minister of lands, are at the head of this undertaking there is still hope. A few select wardens placed at once in the greatest breach, with the able and influential backing of men at home and abroad, should be able to stave off further decimation. Recently Osborn and Anthony (1922, pp. 388–405) published extensive data serving as a convincing plea against the universal destruction of the larger mammals. During the annual meeting for 1922 of the American Society of Mammalogists the question of game protection was followed with eagerness by many.

As a solution of the problem of the permanent preservation of these rhinoceroses, their transportation into another region has been suggested. Before such a move is made, it might be best to try the experiment with a pair or two in the proposed new reserve. Should the venture prove successful there would be then another troop as a nucleus for further expansion.

In this connection it may be well to mention a few factors to be carefully considered in any intelligent scheme of conservation, such as the dependence of the square-lipped rhinoceroses upon suitable wallowing places and pastures throughout the year, their aversion to the proximity of settlements, and their fairly localized habits which make surveillance of them as easy as their destruction by poachers. Sometimes, of course, their nocturnal rambles lead them quite a distance, a ten mile tramp nightly being a conservative figure.

Fortunately the race seems to be very vigorous, as proved by various observations. During 1911–1913, while in the range of the northern form, I noticed that most troops were accompanied by two or three calves in successive stages of growth, the largest nearly equaling the parents in size. In rhinoceroses the period of gestation is generally estimated at seventeen or eighteen months. But in any case the rate of breeding is not as slow as believed. Reproduction apparently commences as early as about the tenth year and continues to a ripe old age. Another encouragement may be derived from the fact that rhinoceroses belong to a fairly long-lived race, as is corroborated in part by Blyth's

statement of a pair of Indian rhinoceroses (*Rhinoceros unicornis*) having lived for 45 years in captivity. It is true the square-lipped rhinoceros (*C. simum*) is the only one of the five known species which has never been brought into captivity, but it would be an experiment well worth while.

Those interested feel that it is the sacred duty of South Africa to make definite and satisfactory arrangements for the adequate protection in a secure refuge for the few remaining South African square-lipped rhinoceroses. Aside from the mere sentiment, in the long run it would pay economically. Big game has been one of the greatest resources of South Africa and in many regions it will remain one of the star attractions for many well-to-do travelers who supply a wholesome distribution of wealth.

As a first step Doctor Hornaday, director of the New York Zoological Park, announces (p. 15) the appropriation of $1,000 by the Permanent Wild Life Protection Fund and now invites other subscriptions to make up the necessary amount of $5,000 to carry on organized protection. Those having at heart the preservation of the surviving members of such a magnificent and practically bygone fauna have what looks like the last chance to come forward to the rescue until the government of the Union of South Africa has time to make arrangements for permanent protective measures.

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American Museum of Natural History, New York City.

OBSERVATIONS ON THE HABITS OF THE STRIPED SKUNK (MEPHITIS MESOMELAS VARIANS)[1]

BY W. KENNETH CUYLER[2]

The writer of this communication has hunted the skunk for many years, during which time he has made the acquaintance, more or less intimately, of many individuals of several species. It is upon the suggestion of Prof. Carl Hartman that these notes have been prepared for publication.

I. GENERAL HABITS

The species of skunk found in the vicinity of Austin, Texas, where the observations were made, are *Mephitis mesomelas varians*, the striped skunk, and *Spilogale indianola*, the spotted skunk. It is to the former species that these notes refer unless otherwise stated.

[1] Contribution from the Department of Zoology, the University of Texas, No. 165.

[2] Note: For the purposes of this study the writer, Mr. Cuyler, is eminently endowed (?) by nature, for he has completely lost his sense of smell. If the skunk musk is present in the surrounding air in concentrated form, however, he may be conscious of it in a general way; hence the musk has some physiological effect aside from its powerful stimulation of the olfactory apparatus.—Carl Hartman.

The skunk is one of the commonest of the flesh-eating animals to be found near Austin. In numbers, it approaches that of its nearest rival, the opossum. In this climate skunks are abroad all winter except for brief cold periods, hence cannot be strictly said to hibernate. They are loathe to migrate from their original homes and seldom do so except in times of scarcity of food. An interesting fact and one which has not been explained, so far as I know, is the great preponderance of males over females (about ten to one) which one captures during the winter. With the coming of warm weather, the ratio of females to males increases. It is possible that through differences in feeding habits the females are the more nearly hibernating.

As a matter of fact, skunks are usually very fat, both in summer and winter. They are omnivorous like the opossum, eating soft, tender roots, and wild fruits, and are especially fond of the "chaparral" berry (*Berberis trifoliata*). Their favorite food consists of grasshoppers, beetles, crickets and other insects, although nothing seems to be more welcome to them than nestling birds or even a batch of eggs. Field mice, young rabbits, and small reptiles are other sources of food. Fresh water clams are often dug for in the loose sands along the banks of a stream, and once it gets the habit, a skunk, like a "coon," becomes a persistent visitor to the hen house, returning night after night until all the chickens are gone or the robber is killed.

Skunks are predominately nocturnal, but may frequently be seen lumbering along in the late afternoon or on cloudy mornings, occasionally picking up a grub or a caterpillar as they go. They are likewise chiefly terrestrial, although they hunt along the edges of streams for frogs or crayfish, and like raccoons even slosh minnows out of the water with their paws. Skunks will take to water when forced to do so. My dogs have often bayed them in creeks where they fought until killed. Upon one occasion a skunk was seen to dive under a rock ledge which projected some eight or ten inches below the surface of the water, and to come out undaunted upon the dry bank.

Skunks are gregarious, going in families from the time the young are old enough to walk until these are able to shift for themselves. The mother, occasionally accompanied by the male, may often be seen feeding with her brood, which averages five or six. In the fall the members of the family separate, but in the winter one often finds dens containing from few to many. The groups may be made up entirely of adults; but I have seen several colonies of which two-thirds of the occupants were half-grown. I got the impression that several pairs denned up

together with their families. In the winter of 1919, I discovered a skunk den some ten feet in diameter, running back in the limestone from an opening eight by eighteen inches. Looking in with the aid of a flashlight I could see at least twelve pairs of eyes, the exact number being hard to count because of the commotion inside.

A skunk den is usually made where a convenient place is found. It happens that Austin is situated upon an enormous geological fault line, the Balcones Escarpment, to the west of which are limestone hills of the Edwards Plateau, and to the east the black-land prairie. In the hills, skunks have ample opportunity to find excellent homes in the innumerable solution caves and crevices. In the prairie country the favorite place for a skunk hole is under a clump of prickly pear cactus (*Opuntia lindheimeri*). Here they seem to be about as numerous as among the hills, for the supply of food is of prime importance in locating a home. The entrance to a nest in an open pasture generally slants down two or three feet, and then runs back comparatively level for an average of six or eight feet. The passageway terminates in the nest which is scooped out sufficiently large to accommodate a family. The floor is covered with a layer of dry leaves, grass, and twigs to the depth of about two inches.

Skunks are reputed never to build a den on the edge of a stream. In my hunting I have seen many skunk dens situated on the edges of the principal streams near Austin. Many skunks make their homes in the small caves and crevices below high-water mark at the foot of Mount Bonnel, an old landmark near Austin situated upon the Colorado River.

The burrow occupied by a family of skunks may or may not have been dug by them. If a hole left by some other animal will suit the purpose, it is taken possession of forthwith. Frequently the den is situated under deserted houses or barns.

When disturbed or startled, skunks utter a peculiar purring sound, and often growl when attacked by man. When handled roughly they sometimes growl, and when fighting they growl and "spit" like an opossum. Some trappers say that the skunk can utter a strong, clear note which resembles the cry of the mink. In a cage, or sometimes when bayed on the ground, a skunk will express its anger by rising upon its hind feet, lurching forward, stamping both front feet, and at the same time clicking its teeth.

Skunk meat, if not contaminated with its own musk, is most palatable. Skunks are easily tamed and make the best of pets. The scent glands need not be removed, for such a pet is harmless unless greatly provoked.

They make better mousers than cats, and may become equally attached to their surroundings. I have kept them in a cage for only a few days and then turned them out expecting them to leave, but the next morning I would find them all curled up asleep in the open cage.

In this latitude the breeding season extends from the first part of April to the last of May. In the latter part of May, and in June and the early part of July, it is not an uncommon occurrence to come upon a female with a number of young which are just able to follow her.

There is a widespread notion that rabies is endemic among skunks, especially in the genus *Spilogale*, hence the names "hydrophobia skunk," "hydrophoby cat," and " 'phoby cat" applied to them. It is even said that the skunks occurring west of the Mississippi River are "sure death," while those east of the river are of a milder type. There is no truth in this additional accusation against the much maligned skunk. I have been bitten several times by skunks and even now have wounds from the bites of two skunks on my fingers. The only precaution I ever use is to rub crystals of potassium permanganate into the abrasions. The teeth of the skunk are usually relatively clean and are never as foul as the teeth of the opossum whose bite generally causes more inconvenience. If skunks carry hydrophobia chronically, then hunting dogs should be more often infected. I know of one dog fourteen years old which has been bitten on an average of four times a month for five months of the year for the last eleven years. That makes two hundred twenty bites in eleven years. She is a healthy animal today.

In this connection Dr. J. T. Wilhite, head of the Texas Pasteur Institute, stated to me that rabies is not more prevalent among skunks than among other species of carnivorous animals. The skunk is, of course, susceptible to the disease, and by its behavior a rabid individual may be recognized. A skunk trailed and treed by dogs is not rabid; but a skunk that attacks man, entering a camp even when this is lit up by a camp fire, is very likely to be rabid.

The fear that the skunk tribe constitutes a reservoir of hydrophobia seems to be not well founded. In this I am in full agreement with J. D. Mitchell (this Journal, February, 1923).

II. THE MUSK AND HOW IT IS THROWN

The musk is contained within two egg-shaped bags varying in size with that of the individual. The walls of the sacs are composed of muscle layers, principally circular, which are supplied with voluntary

nerve fibres. From each sac a duct leads into the rectum, opening near the anus. When the skunk is about to emit a charge, the walls of the anus are relaxed and turned back, leaving exposed to the outside the opening of the ducts leading from the musk sacs. By a contraction of the walls of these sacs, the fluid is forced out in two streams. If the object at which the skunk is directing its stream is directly back of the animal, the streams blend into one a short distance from the opening of the ducts. The distance of the object from the skunk determines the distance at which the two streams blend: the closer the object, the shorter the distance before fusion. An object ten or fifteen feet away would cause the distance to be about one foot from the opening of the ducts to the junction of the two streams. The fused stream then tends to break up into a fine spray before the object is reached. If the object is close, the stream breaks up more quickly. This action may be modified, however, in cases of profound excitement where the stream of musk does not break into a spray before reaching the object. If the object is fifteen feet away, the solid portion of the stream would be about thirteen feet long.

If the object is on the right side of the skunk, the skunk can cover it without moving the position of its head or front feet; but the hind part of the body is directed as much toward the object as possible. The musk coming from the left sac will be directed straight toward the object, and the stream coming from the right sac is at first parallel to the original position of the skunk but blends with the other and stronger stream. Similarly, when the object is on the left side, the main stream comes from the right gland. When the object is directly over the animal the hind part of the body is shifted either to the right or to the left with startling rapidity, and at the same time there is a rotation of the part. Then, without difficulty, the stream can be so controlled as to cover the object effectively. By a further flexion an object directly in front of the animal may also be covered. In fact a skunk can cover any object within its range without altering the position of the fore part of its body. It is astonishing to note the accuracy with which the stream of musk is directed. The writer was on one occasion sprayed with musk at a distance of twenty feet. The animal in this case was an extraordinarily large and vigorous one. The skunk is usually loathe to waste its musk, and therefore does not discharge it promiscuously.

There is a popular idea that the skunk emits a stream of musk upon its tail which it then shakes at the offending object. This belief is erroneous. The skunk is very particular to avoid getting musk on its

tail or any part of its fur. When it discharges the musk, the tail is always held stiff and as far back over its back as possible.

There seems to be some doubt in the minds of the layman or even the naturalist, as to when, and under what conditions, a skunk discharges its musk. The writer has had considerable experience along this line. In hunting skunks, dogs trained for the purpose are used in order that the animals may be taken alive. When caught, they should be grasped by the tail if possible, which is not difficult when they are bayed on the ground; but if they are driven into a hole or up a tree, they are caught wherever a hold is to be had. When held up by the tail a skunk will invariably discharge its musk under the slightest provocation. In this I agree with Professor Dice who has given an interesting account of the actions of a skunk under certain conditions (Dice, this Journal, February, 1921). It makes no difference whether or not its hind feet are touching the ground or braced against any object. During the past winter, the writer was particularly desirous of procuring some female skunks. A hunt was planned, and much to the party's delight, a skunk was bayed a few minutes after starting. Being anxious to determine the sex of the animal, I lifted it by the tail to the level of my eyes and turned a flashlight upon it. This startled the animal and it discharged, with remarkable accuracy, a stream of musk into my eyes.

While being carried by the tail a skunk does not emit its musk unless bumped against a bush or other object. In such a position the animal tirelessly attempts to climb its tail in order to bite the hunter's hands. To keep it from doing so, its hold must be jerked loose; when this precaution is taken, the animal "musks" again.

When a skunk is bayed on the ground it is apparent from some distance that a fight is going on. Whenever a dog approaches its quarry it receives a well directed stream of musk. Most of the "shots" take effect, for the skunk, as has been stated above, seldom releases its ammunition until satisfied that it will be effective.

Skunks have been found not to discharge their musk as freely when they are driven into a hole or under rocks as they do when bayed on the ground, and the hunter's nose does not tell him what the game is; only the character of the dog's bark identifies it. In such situations the animals have to be dug out, but even then there is no evidence of a skunk while the digging is going on. When one is close enough to the animal to catch it, it can be caught by the tail, by the leg, or by its hair, and it can be tugged at in one's endeavor to break its hold and it will not discharge its musk. It is not until the animal is pulled,

scratching and biting, into the open that it will emit any fluid, which it then does with great vigor. Only exceptionally will a more vicious skunk bite and discharge its musk when driven into a hole and disturbed.

Sometimes skunks are driven up trees. Such animals are usually members of the genus *Spilogale*, for *Mephitis* very seldom climbs a tree. But when one is put up a tree, the effects are about the same as when bayed in the open ground. The character of the quarry can be identified by the odor long before the tree is reached. As soon as a person walks under the tree, the stream is directed at him and he feels a fine spray falling.

A grain sack is a convenient article in which to carry the skunks. After a few have been taken and are swung to the shoulder, they may try to climb out. Then when they are shaken down, or if they are punched or struck by a bush, they emit their musk. When not disturbed in this way they usually become satisfied that they cannot climb out, become quiet, and can be carried indefinitely without further annoyance to the hunter. The writer once walked thirteen miles on a railroad track with a sack containing five skunks and not once did they become restless.

When caught in a trap, a skunk will cover the trap with musk until it finds that the trap is not affected. As soon as the trapper comes within sight, the formidable end is turned toward him, and if he goes close enough, he is sure to receive some of the spray. I once caught a large male in a steel trap by its right hind leg. I picked up the chain leading from the trap, and held the animal level with my eyes so as to determine the sex. While examining it, it discharged a stream into my eyes. This skunk had three feet in the air and one in the trap.

While dying violently, as when its neck is broken or it is stabbed in the heart, the animal always exhausts the supply of musk before the heart stops beating. The fluid does not come out in a steady flow as by a continuous contraction of the walls of the musk bag, but is forced out as normally, that is, in jets. This may be done with the animal lying on its back with its four feet pawing the air.

From these observations it is therefore evident that skunks can emit their musk when their feet are not on the ground.

The skunk's musk affects dogs variously. Some vomit and groan as if in great distress, but the spell lasts for a few minutes only. I have often caught as many as fifteen skunks in one night with the same pair of dogs. Other dogs, when they are covered with the musk, get down on their knees and rub head and shoulders on the ground, wallow over

and over in the grass or leaves. Still others the liquid does not affect except for the eyes watering, in which case they paw and rub their eyes.

Persons, like dogs, are affected variously by the odor of the musk. Very few people that I know, however, are actually nauseated by the scent, but a few are made so ill that they are forced to lie down and recuperate before the hunt can proceed. I suppose, however, that if many of those who are not made ill by the odor were to get it as concentrated as do the dogs that bay them, they would become sickened also. To some, particularly to women, the musk gives the sensation of drowsiness and oppression, even though it does not produce nausea. Most people, in fact the majority, the musk smell does not affect at all, although to them the odor is very disagreeable. To a very few the smell seems to act rather as a stimulant.

In common with Dice (l. c.) I have encountered the prevalent belief that a discharge of musk into the eyes causes blindness. The belief is erroneous, as Dice has shown and as I know from observation and experience. I know of a number of persons who have had the liquid discharged into their eyes with no ill results whatever. I have had my eyes filled with it many times and my eyes are perfect. The liquid causes the eyes to burn excruciatingly and the tears flow rather freely for a few minutes. The flow of tears might be offered as an explanation of the fact that some persons say they see more clearly after the experience. If the eyes are wiped or washed, they soon stop smarting, and the vision is as good as ever. Many old trappers and hunters say that a few drops of the musk in the wash water in which a person bathes his face will keep the eye-sight clear, a view to which Burroughs somewhere in his writings gives assent. The experience of dogs which so often get their eyes filled with musk constitutes perhaps the best proof that skunk musk does not destroy the sight. I have this year hunted with one clear-eyed Walker hound that is fourteen years old (same dog referred to above), and has trailed skunks all her life.

Old trappers go so far as to contend that skunk musk is good for a headache. On this point I cannot speak from experience, never suffering from this malady; but in one hunting party that I conducted there was a young lady who started on the hunt with a frightful headache, which disappeared after the capture of an unusually active skunk.

Realizing the difficulty of distinguishing between the taste and the smell of such a substance as the musk of a skunk, I hesitate to discuss the taste of the musk. However, the fluid has a characteristic taste as well as odor. A friend of mine, a member of the zoology staff of the

University of Texas, was assisting me at an operation on an unusually vicious skunk. I was holding the animal and for some reason let go the tail, while my friend, quite off his guard, with his mouth open in a hearty laugh, received a full charge of musk squarely in his mouth. Now Mr. H. differs from the writer in that he is in full possession of all his senses including taste and smell. He states that the musk itself tastes like the concentrated odor of the liquid. It has a sweetish tang and flavor resembling that of analin oil. The musk does not burn the lining of the mouth but has the same puckering effect as gasoline.

In this connection, it might well be said that the musk of all skunks does not smell exactly alike, although there is, of course, a characteristic skunk odor; but a few skunks have a very strong pungent odor somewhat resembling that of burnt cork, feathers, or other organic matter.

The discharged musk spreads throughout the surrounding atmosphere with remarkable thoroughness. As has been said, the fluid of a bayed skunk is emitted in a stream which spreads into a fine spray. In our hunting parties there usually is someone who keeps his distance, yet when he reaches home his clothes smell as though he had come into close contact with one of the animals. I am also told that the skin of such a person smells like musk and that it is difficult to eliminate the odor. Usually every one on a skunk hunt is thoroughly saturated with the odor by the break of day when the hunt is over.

There are many ways of partially eliminating the odor of the skunk from one's skin but there are very few means which are sufficiently strong to kill the odor immediately. In fact it is nearly impossible to deodorize the skin or clothing permanently by a single cleansing, but some methods are capable of reducing the odor to the point where close examination is necessary to detect it. The hands even after many washings may seem free from the skunk odor which is brought out again when the hands are warmed over the fire.

Gasoline or ammonia will take off the smell thoroughly enough to make the odor inoffensive or even unrecognizable after the first washing. A few drops of crude carbolic acid in a pan of water together with a drop or two of oil of wintergreen will also eliminate the smell for the most part. To bury the clothes for a certain length of time and to let them soak in running water are old methods of cleansing, said to be effective. The ordinary treatment of soap and water has little effect upon the odor, removing only the strong, fresh smell.

Hunters and trappers, in territory where cedars or junipers grow,

eliminate the odor of the musk more nearly completely and permanently by the use of smoke made by burning cedar leaves. We carry out this procedure by starting a good fire first and then piling on a large quantity of green juniper branches of the species *Sabina sabinoides*. This makes a large volume of thick smoke. The article to be deodorized is then held in the smoke for a few minutes, since only a short time is necessary. The hands or face, clothing, hides, traps, or any article that can be held in the smoke can be freed from the odor in this manner. I have found no other method as effective as this.

Austin, Texas.

THE SKULL OF THE WOLVERENE (GULO LUSCUS)

By R. W. Shufeldt, M.D., C.M.Z.S.

[*Plates 21–22*]

There has been no general work issued on the skulls of the Mustelidæ of this country since the late Dr. Elliott Coues published, in 1877, his elaborate volume on the "Fur-bearing Animals," a treatise issued by the United States Geological Survey of the Territories, then under the Department of the Interior and the direction of F. V. Hayden, United States Geologist. This work is widely known among mammalogists, and has justly been considered a standard on the subject from the day it came off the presses until the present time. It was prepared with great elaboration, and the subject matter is set forth on some three hundred and thirty odd pages; while the illustrations, which follow the text matter, consist of sixty figures on twenty plates. These latter are crude examples of wood-engraving of the sort published by the government nearly half a century ago. They but poorly second the remarkable mass of scientifically presented information the work contains, and it was the style of these figures that called for far better ones and these have been secured by means of photography and the use for that purpose of a fine specimen of a skull of a wolverene kindly loaned by the United States National Museum from its collections (♂, 200696). With the same loan came the skulls of various other American mustelines, and their craniology will be touched upon in later papers.

Coues, in his chapter on *Gulo luscus*, devotes about four pages (37–41) to the description of the skull and teeth of the animal, and it closes

with a table setting forth the measurements of skulls of European and American specimens. These measurements present considerable variation, and were taken from "a very large (Fort Good Hope) and another (Peel's River) rather small American skull with those of a specimen from Lapland." Some 15 diameters or measurements are recorded in this table, and selecting one of these as an example, it may be stated that Doctor Coues found the "total length from the apex of intermaxillary to occipital protuberance to be in the Lapland skull 5.50 inches; in the Peel's River specimen 5.75 inches, and in the Ft. Good Hope skull 6.00 inches." Now in the skull here to be described this same measurement is greater than any of these, the distance being 6 and five-eight inches (16.8 cms.). This specimen was collected in Siberia, on the Lesser Annui River, by Mr. C. Amory, Jr. (308, March 12, 1915).

Plate I of the "Fur-bearing Animals" is devoted to three views of a skull of *Gulo luscus*, namely an upper one, a side view, and one from beneath or basal view. The length of this skull is 10.1 cms., the mandible having been removed in the superior and basal views, while it is articulated in the middle figure or lateral view. In that it was removed from the other two, it is fair to presume that it was removable without breaking away either the anterior or the posterior glenoid process upon either side, which processes in the specimen at hand have become so far produced forwards and backwards as to hold the jaw permanently articulated. It would be impossible to separate it from the skull without completely breaking away the prominent osseous lip of the mesial angle of the posterior glenoid process upon either side. Either one of these processes is very extensive; and while the pair allow of a perfect up and down movement of the mandible in the glenoid cavity, they, at the same time, permit the bone to slide to some little extent from side to side in a direct line. The jaw may be opened to the extent of some eighty degrees, the base line being the line of the alveolar process. Further opening is most efficiently prevented through the contact that takes place through the supero-anterior angle of the coronoid process coming in contact, upon either side, with the anterior wall of the orbit below the anterior ending of the zygoma. Coues's figures of the skull of *Gulo luscus* are, in each figure, reduced rather more than one-half the length of the original; and, while well drawn in some respects, they all, as in all woodcuts of this class, are almost entirely lacking in the presentation of the minor details of the skull. Especially is this to be seen in the charac-

ters of the teeth; in the absence of many of the smaller foramina, and in a total lack of character due to the disregard of definition of outline, or lack of sharpness defining borders, lines, perspective, and the rest.

As will be noted in the two plates illustrating this article, the low, sharp, sagittal crest of this skull is produced posteriorly as a conspicuous, thickened *supraoccipital crest*, which, for its entire median posterior aspect, presents a fine, incised line, indicating that either moiety of this process is furnished by the parietal bone of the same side. In Coues's figure this process is much reduced and not particularly conspicuous.

The sagittal crest terminates on the cranial vertex, at a point opposite the coronoid process of either side of the articulated mandible, at which point it symmetrically bifurcates, either low ridge curving downwards and outwards to terminate at the apex of the superior process of the orbital rim. This curved line, upon either side, anteriorly bounds the enormous temporal fossa for the powerful temporal muscle in life; while, taken together, they bound, posteriorly, the smooth, lozenge-shaped area of the vault of the cranium, which terminates anteriorly over the great elliptical narial aperture, the plane of which is oblique—an obliquity of 45°, running upwards and backwards from the teeth in front (Plate 21).

On a lateral view of the cranium, then, the median line, from the central incisor teeth to the apex of the supraoccipital process, is a convex one, the highest point of the convexity being, as already stated, opposite the posterior boundaries of the orbits. One third of the marginal rim of an orbit is incomplete posteriorly, as shown in Plate 21. The *infraorbital foramen* is large and elliptical in outline, the major axis being vertical. As will be noted in the figure, the *zygoma* forms a bridge of great strength and width. It stands well away from the side of the cranium upon either side (Plate 22), making a right angle posteriorly to turn toward the skull, and, inferiorly, to furnish the abutment for the glenoid articulation for the mandible. At either abutment of the zygoma marked massiveness and strength are apparent. The inferior aspect of these zygomata are here well shown in Plate 22, which, when taken in connection with what we see in Plate 21, gives an excellent idea of this feature of the cranium.

The dentition of the wolverene is correctly described in great detail by Doctor Coues in his above quoted work, and he truly remarks that "in a large proportion of the skulls which come to hand, the

canines and sectorial teeth are found cracked, even split entirely in two or broken off, apparently a result of the desperate exertions of the captured animals made to free themselves from iron traps" (p. 40). This is the case with the teeth of the skull in hand, which, as above noted, is from a Siberian specimen. In it not only is the sectorial tooth of the jaw vertically cracked through its posterior cusp, but both the canines of the upper jaw have their apices extensively broken off.

Turning to the basal aspect of this cranium (Plate 22), it is to be noted that the roof of the mouth is an extensive area; thick; moderately concaved throughout, and presenting the usual small foramina as well as a rather large pair of anterior palatine foramina. These last, placed side by side, are well separated, elliptical in outline, with the major axes parallel to the median plane. The palato-maxillary suture is still visible, but the premaxillary and maxillary have completely fused, leaving no sutural trace to indicate their boundaries. A pair of *hamular processes* of the pterygoids are well developed, each being a slender spicula of bone, curving outwards.

All sutural lines among the bones in this region have almost entirely disappeared, and to define the *vomer* is quite impossible. Upon the other hand all the foramina of this region are in plain evidence at their usual sites, and this, too, refers to those occurring within the limits of the orbital cavity, the latter being only definable anteriorly. As a matter of fact, nearly all the sutural traces among the bones of this very old wolverene have disappeared, leaving but little by means of which we can locate boundaries with exactitude. Two well-defined quadrilateral depressions occupy the basioccipital area, they being separated, mesially, by a distinct ridge of bone. To the outer side of either of these we find an auditory bulla, about and upon which occur the usual foramina of the region under examination.

The *foramen magnum* is large, elliptical in outline, with the major axis transverse; while upon either of its lateral borders there is present an extensive occipital condyle. Inferiorly, these merge with the thickened margin of the foramen, the superior margin of the latter being somewhat raised and inclined to be sharp.

Above, and to either side of the characters last defined, we have a moderately concaved supraoccipital arc, bounded all about by a more or less sharpened and conspicuously raised crest. On either side, externally, this runs out to the enlargement immediately posterior to the aural aperture, while inferiorly it is carried out to the inner apex

SKULL OF A SIBERIAN WOLVERENE (GULO LUSCUS), ♂, NO. 200696, COLL. U. S. NATIONAL MUSEUM. NATURAL SIZE

(Shufeldt: Skull of the Wolverene.)

SAME SKULL AS THE ONE SHOWN ON PLATE 21. BASAL VIEW

Mandible permanently articulated, and in order to remove it, one of the glenoid processes upon both sides would have to be broken off.

(Shufeldt: Skull of the Wolverene.)

of either paroccipital process. A valley occurs between the latter and the occipital condyle of the same side. Some of these characters may be seen on Plate 22, especially those of the auditory bullæ and other parts described above.

In the wolverene the mandible is a most massive bone and one of great strength. Anteriorly, the symphysis is extensive and completely fuses the two rami, thus causing the jaw to become a solid, single bone. Its general surface, anteriorly, is convex, while the upper surface of this symphysial part is almost flat and in the same plane with the rounded alveolar border. As will be noted from the figures of the plates, this animal possessed a wonderful set of teeth, and those of this mandible are most elegantly arranged in their sockets; the entire armature, during life, must have been quite equal to inflicting a bite of unusual severity.

This jaw, in its entirety, is of the V-shape form (Plate 22), with its inferior borders well rounded off. There are two *dental foramina* upon either side, being situated half way between the alveolar border and the posterior termination of the symphysis.

Either ramus of this mandible is broad, rather thin, and flat upon both sides, with the entire margin rounded off. Its free coronoid process possesses a semicircular outline, while a considerable concavity is found upon the outer surface of either ramus, on the external side between the body of the bone and the condyle. Quite a process is developed at either angle, it being flat upon its lower side, where the surface is in the same plane with the lower border of the body (Plate 21).

Either condyle is very elongate, sessile, its long diameter being at right angles to the body, and the juncture at the middle of the condyle. The *inferior dental foramen* is rather small and the entrance to it very oblique.

Taken in its entirety, every character and part of this skull clearly indicates that, in life, it belonged to a mammal possessing great strength and a ferocious disposition, and one capable of giving a tremendous bite.

Washington, D. C.

THE DELPHINUS OCCIDUUS OF LEIDY

By Glover M. Allen

The first fossil cetacean to be described from the west coast of North America was briefly diagnosed by Leidy in 1868 as *Delphinus occiduus* from a fragment of a rostrum found in a Miocene formation at Halfmoon Bay, near San Francisco, California. The type specimen was received by the Museum of Comparative Zoölogy in 1895 from the J. D. Whitney collection. It was examined by the late F. W. True and afterward briefly described and for the first time figured by the late C. R. Eastman who remarked that its relationship to *Delphinus* was of a most general nature only. It has continued to be included in various lists of fossil mammals as *Delphinus occiduus* until in 1920 Jordan and Gilbert for no obvious reason transferred it to *Phocæna*. The most casual inspection of the type fragment, however, is sufficient to show that it is in no wise referable to the genus *Delphinus* as at present used, nor is it any whit nearer to *Phocæna*. But in certain details it so strongly recalls the living *Stenodelphis blainvillii* that there can be little doubt of its general relationship to that genus, at present known from the La Plata estuary, its adjacent coasts and the large rivers emptying into it. The differences, however, are important and seem to warrant the erection of a new genus for the fossil:

Lonchodelphis genus nov.

The genotype is *Delphinus occiduus* Leidy, based upon a fragment about 130 mm. long from the posterior portion of the palate (no. 8765 Museum of Comparative Zoölogy). It includes the alveoli of 19 teeth on each side though the right-hand portion of the tooth row is slightly longer than the other. The alveoli are circular in outline, indicating simple conical-rooted teeth, and vary from 4.5 (left posterior) to 7 mm. in diameter. There are 8 to 8.5 sockets in a space of 50 mm. Each alveolus is distinct from the others, and is separated by complete bony bridges across the tooth row. In *Stenodelphis* there is a continuous dental groove and the teeth appear to be directed more outward than in *Lonchodelphis* in which the direction, as indicated by a root still in place, was more nearly perpendicular. The palate contracts very rapidly forward, while at its posterior end the tooth rows in expanding rise slightly above its general level.

In *Stenodelphis* the vomer appears as a median elevation on the palatal floor with a slight groove on each side. These two grooves run together nearly opposite the end of the tooth row to form a deep median trough that narrows and becomes shallower as it runs forward. Its sides are rounded, curving into the flatter palatal portion of each side, which forms about one-quarter the width of the rostrum. In *Lonchodelphis*, on the contrary, the part of the palate between the posterior ends of the tooth rows is nearly flat and the median trough does

not begin until almost the point where the taper of the rostrum ends, that is, at about the level of the sixth tooth from the posterior end of the fragment. The trough is relatively much wider, with steep, diverging sides so that the flat palatal strip on each side between the tooth row and the edge of the trough is relatively very narrow, about one half the width of the alveolar line, with which (as in *Stenodelphis*) it is in nearly the same plane. The vomer is traceable as a narrow, lozenge-shaped strip about 40 mm. long in the posterior end of the median depression, but is apparently not visible on the flat portion of the palate between the ends of the tooth rows.

In lateral aspect, the intermaxillaries (though almost wholly broken away) were evidently marked off by a longitudinal groove still faintly traceable along the line of junction between them and the maxillaries. As in *Stenodelphis* the combined width of the intermaxillaries above was apparently uniform from close to the end of the tooth rows forward. There is a slight asymmetry, however, so that beyond the base of the rostrum the right intermaxillary extends out as far as the outer border of the maxillary, whereas on the left side the maxillary slightly exceeds the width of its intermaxillary.

Although True finally considered *Stenodelphis* as a possible member of the Delphinidæ, and Winge later placed it in the Platanistidæ, the recent researches of Miller seem to indicate that in cranial structure *Platanista* stands in a family by itself, while *Stenodelphis*, *Inia* and *Lipotes* may be considered a separate family, Iniidæ, to which the extinct genus *Lonchodelphis* is now referred.

The synonymy of its only known species follows.

Lonchodelphis occiduus (Leidy)

Delphinus occiduus LEIDY, Proc. Acad. Nat. Sci. Philadelphia, 1868, p. 197; Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 7, p. 431, 1869; 4th Ann. Rept. U. S. Geol. Surv., Wyo. and portions of contiguous Terr., F. V. Hayden in charge, 1871, p. 365.—BRANDT, Mém. Acad. Imp. des Sci. St.-Pétersbourg, ser. 7, vol. 20, p. 286, 1873.—COPE, Amer. Nat., vol. 24, p. 616, 1890.—ROGER, O., Ber. Naturw. Ver. f. Schwaben u. Neuburg, vol. 32, p. 79, 1896.—TOMES, C. S., Manual Dental Anat., ed. 5, p. 376, 1898.—TROUESSART, Cat. Mamm. Viv. et Foss., pt. 5, p. 1031, 1898; Supplement, pt. 2, p. 765, 1905.—HAY, Bull. U. S. Geol. Surv., no. 179, p. 594, 1902.—EASTMAN, Bull. Mus. Comp. Zoöl., vol. 51, p. 93, pl. 4, fig. 1, 1907.

[?] *Phocaena occidua* JORDAN AND GILBERT, Leland Stanford, Jr., Univ. Publ., Univ. ser., Fossil Fishes of Southern California, II, p. 59–60, pl. 9, fig. 2; pl. 28, figs. 1, 3, 1919 (see Palmer, Journ. Mamm., vol. 1, p. 100, 1920).

It may be noted that the vertebræ described and figured by Jordan and Gilbert as *Phocaena occidua* may turn out to belong to some other species than that under discussion, for which if generically distinct, the name *occidua* would then be available, dating from these authors.

Cambridge, Mass.

HERLUF WINGE, 1857–1923

By Adam G. Böving

On the tenth of November, 1923, in his 67th year, the Danish zoologist Herluf Winge passed away. His death was sudden and unexpected. One morning he was found dead in bed. There had been no previous illness and the end was very gentle.

For Scandinavian zoology this means the loss of one of its most prominent scientists. Outside of the Scandinavian countries, however, Winge was little known, for he insisted upon writing his papers in Danish and refused even to summarize them in one of the generally recognized world languages.

Being a talented linguist himself he was firmly convinced that it would be an easy matter for a scientist of any country to learn as much Danish as might be required to read his works. He loved his mother tongue and felt that only in this could he find the expressions and grammatical constructions which completely covered his ideas. His style was pure and beautiful.

Here in North America Winge is better known than in any country outside of his own, due especially to G. S. Miller of the National Museum in Washington, who has translated his important paper on the relationship of the whales.

Before his death Winge finished a revised edition of his entire work on the relationship of the mammals which formerly had been published in parts in many places. Its first volume has already appeared, the second volume is in print and the third and last one is completed in manuscript and will come out in a short time as Winge in his will has left sufficient money for this very purpose. It is to be hoped for the good of science that this work also will be translated into English.

One of Winge's first papers dealt with the changing of the teeth and the various tooth forms in mammals. He derived the differently shaped molars of the recent forms from the tricuspidate molars of the Jurassic mammals and these again from the simple conical teeth of the reptiles. A new and logical tooth-formula instead of the one hitherto generally used was also given in this publication.

In 1885 he became connected with the Zoological Museum in Copenhagen. Here a great part of his time was given to comparative morphological studies of the huge collections of skeletons and bone-fragments of the prehistoric animals which the Danish zoologist P. V.

Lund had unearthed from limestone caves in the interior of Brazil and donated to his own country.

In "E Museo Lundii," which consists of three large volumes with 75 plates, splendidly drawn by the author, he describes the entire material of mammals in the collection and discusses the relationship between these extinct animals and the present fauna in South America. But it was not only with this tropical fauna that he was working in the museum. He also made himself thoroughly familiar with the vertebrates of the far North. His papers on the mammals and the birds of Greenland are models of historic and faunistic zoology and treat problems of extreme interest to American science.

His specialty, however, was the vertebrates of the Scandinavian countries. His knowledge about their biology was marvelous, and he knew their anatomy so intimately that he could determine the minutest details of their skeletons, hair or plumage. His treatises on domestic and game animals found in the kitchen-middens of Denmark are therefore of particular scientific value. But the author did not confine himself to elaborate remarkably complete lists and exact descriptions of the relicts. By inferences from the presence and the absence of certain forms he explains with great ingenuity the kind of climate which reigned in this prehistoric period, the kind of trees which prevailed in the woods, the extent of the forests and the location of the open land. He pictures the life and customs of the old inhabitants from the finds of bones or tools made from bones of the characteristic game and domestic animals. To the latter he gives a particularly careful study and proves that the people of the second part of the Stone Age housed several animals besides the dog and therefore were not typical hunters and fishermen.

Later on, in special treatises, he took up the question of the origin and the different races of the domestic animals as they appeared in Denmark from the stone ages to the end of the mediaeval time, and he discussed the great changes which are found in their build and size during these periods.

For about 25 years, till 1911, he published annual reports on the birds fallen and collected at the Danish light houses and light-vessels. Since 1911, the preparation of these reports has been continued by R. Hörring.

Besides the long series of purely scientific papers Winge has contributed several of a more popular character on mammals and birds, foremost among these being an admirable Fauna dealing with the mammals of Denmark.

Winge was an enthusiastic follower of the Lamarckian theory on evolution in its original form, not a "Neo-Lamarckian" of the more modern American type. Already in the first of his publications he adopted this view at a time when most scientists believed in or were leaning toward "Darwinism" and he continued through all his life to accumulate valuable information to support it. His adherence to "Lamarckism" had the character of a creed and often caused his otherwise critical mind to be guided more by imagination than by direct observation when he discussed evolution.

To most people he was the typical "Museum Scientist," the official who kept his material in perfect order and condition and "never made a wrong determination." During the customary Danish 3½ hours' daily office-work his room was a meeting place for visitors of all ages and social positions. He was always a kind and tactful listener, and possessed a remarkable gift for offering clear, brief and full information. It was not unusual to find Winge in the large hall of the museum, surrounded by a crowd of ordinary hand-laborers or farmers or a class of school-boys, explaining different groups of animals or a single interesting mounted specimen or the huge skeletons of the extinct mammals from Brazil. He was a very eloquent teacher. But this same man never read a paper in any scientific society and took no part in public scientific discussions, in fact very seldom—if ever—came to scientific meetings or congresses.

Out of office he did not mingle with men. He avoided company and since the premature death of his gifted brother, the ornithologist Oluf Winge, made all his excursions by himself.

Typical bachelor as he was he stayed alone in his large, comfortable villa at the charming saltwater way "The Sound" near Copenhagen, giving all of his time to investigation, thinking, reading and writing. His house was built in the midst of a good sized plot of trees where every plant was left undisturbed and all kinds of wild animals—both birds of prey and songsters, martens and mice—had the place for themselves without the interference of human beings. He was intimately acquainted with the flora and fauna of his plot, but never picked a flower or killed an animal. He hated hunters from the bottom of his heart and told them so.

His appearance was unusual. He was of medium height, rather frail and slightly stooped. He walked quickly and on the street always carried an umbrella. His forehead was broad and beautifully built, his nose small, his eyes blue with a mild and firm expression

behind golden spectacles. He wore thick reddish whiskers which contrasted strangely with his womanish complexion. His voice was high-pitched and distinct, but musical and agreeable. His manners were cultivated and polite. He was always fastidiously dressed and never appeared in anything but the old fashioned black Prince Albert. It is characteristic of his shyness that he resented strongly having his picture taken. Two or three good snapshots, however, were lately secured by some of his younger colleagues in the museum.

Winge was very well off financially. In his will he left his large library, his collections and his entire fortune to the library and museum of the University of Copenhagen to be used for the advancement of the zoological studies to which he had devoted his life, and for the preservation of the wild animals in Denmark.

U. S. National Museum, Washington, D. C.

GENERAL NOTES

THE RANGE OF CRYPTOTIS PARVA (SAY)

Through the kindness of Mr. H. D. Boyes of Wray, Colorado, the Colorado Museum of Natural History was recently allowed the opportunity to examine a specimen of *Cryptotis parva* (Say). The specimen was one of two of the species that Mr. Boyes has secured at his ranch on Dry Willow Creek, eastern Yuma County, Colorado.

Heretofore, none of the short-tailed shrews have been reported from Colorado; in fact, no shrews are known from the plains region east of the mountains, with the possible exception of *Notiosorex crawfordi* (Coues) which has very doubtfully been reported from the extreme southeastern section of the state. The known range of *parva*, therefore, is extended westward from eastern Texas and eastern Nebraska to eastern Colorado, and will doubtlessly be found to include most of Kansas and Nebraska.

Dr. H. H. T. Jackson, of the Biological Survey, kindly confirmed the identification of the specimen.—F. W. MILLER, *Denver, Colo.*

THE GROSS WEIGHT OF WOODHOUSE'S WOLF

The gross weight of wild animals, from a meadow mouse to a grizzly bear, has often puzzled me, and when I asked hunters and other field observers for their opinion, I found that their estimates were often unwittingly exaggerated. While in the Forest Service, stationed in the Wichita National Forest and Game Preserve, in the Wichita Mountains of Oklahoma, I weighed eight male Woodhouse's wolves which we killed with strychnine, between January 8 and February 9, 1917.

Seven of these animals were in the prime of life, although one of them, which weighed 31 pounds, had badly worn teeth. The eighth wolf was not quite grown. The skin of the smallest adult (which weighed 26.50) weighed 2.50 pounds when quite fresh.

The immature wolf was taken January 28 and weighed 24 pounds, while the other seven weighed 26.50; 30; 30.50; 33; 29.50; 33.75; and 31 pounds respectively. These figures give an average winter weight of about 30.67 pounds for adult males of the Woodhouse's wolf, from the Wichita Mountains.

I am sure that these weights are fairly accurate, for in each instance I took the animals to headquarters to weigh and skin them; in no instance was there an unusual amount of water in the animal's stomach; and the scales which I used were of the steelyard type.

Mr. R. Chester Hughes and the writer identified one of these animals and other individuals from this locality as *Canis frustror* Woodhouse.—E. D. Crabb, *The Public Museum, Milwaukee, Wisconsin.*

A "MAD STONE" FROM A DEER

On December 12, 1923, Mr. C. O. Fisher, a deputy of the California Fish and Game Commission, sent me a "mad stone" that had been taken from the "small pouch" of a three-point buck deer killed by Howard Hawk on Davis Creek near Minersville, Trinity County, California, during the last days of the season, 1923. With the specimen came a request for information regarding mad stones. Search in mammalogical literature failed to disclose any references to mad stones from deer and recourse was had to works on veterinary science. For the benefit of others who might, because of this note, be saved a similar search for information, I offer the following digest taken from: Hoare, E. W. 1915. A system of veterinary medicine (Alex Egen, Chicago), 1623 pp.; Hart, G. H. 1908. Rabies and its increasing prevalence. U. S. Dept. Agric., Bur. Anim. Industry Circ. 129, 26 pp.; 1904. Special report on diseases of cattle. U. S. Dept. Agric. Bur. Anim. Industry, 553 pp.

In the stomachs and intestines of many mammals various hard masses of material are to be found. In cattle, the colon and sometimes the second stomach are most likely to contain "hair balls" or calculi. Such names as ægagropiles for false calculi, and enteroliths or benzoars for true calculi are used in medical literature. Calculi, stone-like masses, seem to have their beginnings in some foreign body such as a nail or a pebble, and are largely a concretion of ammonio-magnesium phosphate and lime salts. Masses of hair licked from another animal often form the basis of hair balls. The movements of the stomach wad up the hair into a sort of pellet to which there slowly adheres additional fibrous and other material. Such bodies are also found in man.

Similar mad stones are found in the larger wild mammals. Before the cause and cure of rabies was understood, such objects, taken from animals, were believed to be valuable in the cure of the bite of a mad dog. Especially in the South did this superstition exist. One of the usual tests was the application of the mad stone to the wound. If it adhered it was believed to have potency; whereas, if it fell off it was supposed to have less curative value. Naturally, a mass of fibrous material which would absorb blood was the kind which would stick to the wound and, therefore, was the kind most highly prized. The longer the mad stone adhered to a wound the more potent it was, according to belief, in warding off the disease. In the southern states mad stones were often passed down through many generations and were as carefully guarded as some precious

heirloom. Cases have been known where people have made long journeys and paid large sums of money to have a mad stone applied.

It should be needless to point out to readers of the present day that a "mad stone is a no greater specific than blotting paper." The cause and cure of rabies is now well known.

The fact that mad stones from deer have been considered especially valuable makes a description of the one at hand worth while. It is a brownish mass of material, cylindrical in shape, 2½ inches long by ⅞ of an inch in diameter. The basic material appears to be some tough fibrous substance, perhaps from roots, matted together. Around this basic material is a quantity of more finely ground vegetable matter adhering closely to the nuclear mass, giving the mad stone a smooth, roundish appearance. It is light in weight and has absorbent qualities.—HAROLD C. BRYANT, *Museum of Vertebrate Zoology, Berkeley, California.*

THE RANGE OF AN INDIVIDUAL DEER

That deer travel considerable distances in winter and summer migrations is well known, but when an attempt is made to determine the range of an individual, little data is available. Marking experiments with salmon have largely determined the distances covered by this fish. Recent banding experiments with birds are helping to establish the maximum range of the individual and the actual route and distance covered in migration. But where have experiments been made with mammals!

The marking of a female mule deer (*Odocoileus hemionus hemionus*) in Yosemite National Park a few years ago with subsequent reports brought the following information relative to the distance covered by an individual deer, even though the marking was not planned with this idea in view.

In 1921, Ranger Henry Skelton and his brother, stationed at Cascade, about eight miles down the canyon from Yosemite, took an interest in a tame doe with two fawns. Incidentally, one of the fawns became so injured that it was mercifully killed. The doe became so tame that it could be petted. In sending to a mail-order house for materials, a small bell was noted in the catalogue and was ordered, that it might be placed around the neck of the tame doe. Having been thus marked with a leather collar and a bell, the doe was continuously seen in the vicinity during the rest of the summer. In the following summer (1922), this same doe with the bell was reported along the south rim of Yosemite Valley on the Pohono trial. During the past summer (1923), the same animal was reported many times from Little Yosemite Valley, a minimum distance of seventeen miles from the place where it was first belled, and in the summer of 1924 along the Half Dome trail about four miles north of its 1923 habitat. She has wintered regularly at Cascada. It is hoped that additional reports of the same deer will be secured another summer.

In that the importance of the record grows with the length of the life of the animal, it can readily be seen that a national park, where all animal life is carefully protected and where there is practically no poaching, is an ideal place for experiments of this kind. The intensive hunting of the present time would make it difficult to carry on the same experiments with buck deer in any place except a national park or game refuge. We hope this may be but a pioneer record among

many of similar nature to appear in the future.—HAROLD C. BRYANT, *Museum of Vertebrate Zoology, Berkeley, California.*

BREEDING RECORD OF BEAVER

Through the kindness of Mr. A. T. Wheeler, a government trapper in this area, I recently received the gravid uteri of two beavers (*Castor c. frondator*). Each uterus held three embryos, of 7 mm. and 9 mm. greatest length.

The beavers were taken from a colony in South Boulder Canyon, Boulder County, Colorado, February 23, 1924. This is regarded here as an early record for the breeding of these animals, and is said by Mr. Wheeler to be the earliest that he has observed in several years' trapping.—EARL THERON ENGLE, *University of Colorado, Boulder, Colorado.*

A MUSKRAT MOVES ITS YOUNG

Monument Valley Park, Colorado Springs, has several small lakes or ponds within its limits, all of which, at least at times, have muskrats living in them. The afternoon of July 2, 1921, I was walking along the westerly shore of one of these ponds in the north end of the park. There is a small island in this pond, and I noticed a muskrat swimming from the easterly side of it, and stopped to watch it, without the least suspicion that anything especially interesting was going to happen. The animal held a pretty steady course toward the west shore and presently got so close in under the bank that I could not see it, so I cautiously stepped forward to watch. While I was standing there the animal suddenly made its appearance, from a hole in the bank, with something in its mouth which looked like either a very young muskrat or a very large field mouse, and swam back toward the island.

While she was making this return trip I noticed a peculiarity in the manner of swimming, and one which I noticed on every succeeding trip when she was carrying young. The animal swam with her head quite high out of the water, presumably to keep the youngster from drowning, and at the same time the posterior third, and I think oftentimes half, of the tail was elevated above the water, literally waving in the air. When returning from the island for another baby the animal swam in the usual manner with the tail submerged.

After the muskrat had returned to the island, I remained to see if she would make another trip and presently a ripple showed that she had started. She swam directly toward the hole, the mouth of which was in the bank about a foot back from the edge of the water, and few inches above the water. Entering the hole she soon reappeared with another young one. By this time I was becoming decidedly interested and stationed myself not far from the burrow. As it was Sunday afternoon there were several people about, including children, but after I had explained to them what I was doing, they either remained to watch quietly with me, or went away and left me in peace. A dog made some trouble and frightened the muskrat away as she was returning on the fourth trip, but after it went away she made several more trips, up to a total of seven. I timed the animal. It took two minutes to swim in either direction, and she spent about two minutes at the island, while she remained in the hole from 30 to 70 seconds. Altogether I watched her for about an hour, from 4.30 to 5.30 p.m.

It was difficult to see just how the young were held, but after seeing her depart with several I decided she must be holding them by the skin of the belly, and I think the head was always to the left, and the tail to the right. While she usually carried her head high enough so that her burden was high in the water, yet occasionally she dived with it, but came to the surface almost immediately.

I presume the reason she was moving her family was that the entrance to the burrow was out of water, and therefore dangerous, the level of the pond evidently having been lowered. While of course I know nothing about the situation of the new home, doubtless its entrance was under water as is customary with these animals. In any event the island was a much safer place for the young to be brought up. Usually the animal landed directly at the hole, but once or twice she came ashore a few feet away and walked to it.

It is interesting to note that in the summer of 1923 a cottonwood tree was cut on this island by a beaver, and another was nearly or quite girdled. One of the park employes told me that beavers quite frequently come to these ponds, stay a few days, and then leave. Monument Creek flows through the park, and these animals doubtless follow the stream down from the colonies 15 to 20 miles above, and wander over to the ponds.—Edward R. Warren, *Roosevelt Wild Life Forest Exp. Station, Syracuse, N. Y.*

CHANGES IN COLOR OF HAIR DUE TO FOOD

Very little, if anything, is known of the conditions, aside from heredity, which influence the color of the hair. Although in general the color and pattern is very stable there is some evidence that the tone may be altered to some extent by changes of environment, the word being used in senso lato. There is, however, as far as I am aware, no experimental evidence which points to any single factor as bringing about a color change in the coat of an animal and in view of this fact the following result may prove of interest.

If young rats are placed immediately after weaning on a diet containing among other things 10 per cent of cod liver oil, the white portion of their hair becomes changed in a short time to an intense dirty Indian yellow. Numerous control animals maintained in the same surroundings prove these changes to be due to food alone.

While it cannot be stated as fact, in all probability this pigmentation represents the secretion of certain carotinoid pigments from the cod liver oil and their storage in the hair. The action of such a diet on the hair is apparently selective since the skin and mucous membranes are not stained.

There can be doubt or denial that a regimen including so large a quantity of pigmentiferous oil would hardly be duplicated under natural conditions, nevertheless the result is of a certain interest as showing that food may play a part in the determination of the color of the coat, and opens a fertile field for further investigation.—P. G. Shipley, *Department of Pediatrics, Johns Hopkins Hospital, Baltimore.*

RECENT LITERATURE

Miller, Gerrit S., Jr. LIST OF NORTH AMERICAN RECENT MAMMALS, 1923. Bull. U. S. Nat. Mus., no. 128, xvi + 673 pp. [Issued April 29,] 1924.

A first requisite for any thorough faunal study of a given group is a list of its species known to occur within the area considered. The present List of North American Recent Mammals to the close of 1923, offers not only a concise and carefully prepared catalogue of this sort but a great deal more besides; for, as in Miller's List of 1912, it includes for each species the citation of the original name and reference and that of the first use of the Latin name in its currently accepted combination, as well as an accurate statement of the type locality and, in case of recently studied groups, the range. In this part of the work it has been the author's aim to act as historian only, indicating merely the current condition of the nomenclature for each group as reflected in the literature, without attempting to express a direct opinion as to the status of any accepted species or subspecies except in certain cases which would mean the perpetuation of confusing errors. This course has led to a small amount of inconsistency, as in the treatment of certain island forms (*e.g.*, *Erophylla sezekorni syops* is raised to specific rank to accord with the treatment of the other members of the genus); yet it is obvious that some other method might lead into other difficulties, and in general where there are differences of opinion in regard to the status of species in "unrevised" groups, references to the conflicting views are included. Authors' names following the Latin names are placed in parenthesis "when two references are required to explain the combination" adopted, but this use is contrary to that originally and now generally intended, namely, that the parenthesis merely indicates a change in the *generic* name from that of the original combination. The arrangement of the major groups is in general accord with the outlines of Osborn and of Cabrera but the sequence and in part the classification of minor groups, genera and subgenera, is based on original study and aims to proceed from the less specialized to the more highly evolved.

The facts thus concisely presented afford an extremely useful and interesting résumé of our knowledge of North American mammals from the systematist's point of view. When in 1885, the late Dr. F. W. True prepared his "Provisional list of the mammals of North and Central America and the West Indian Islands," he was able to marshall but 363 names. Shortly after, through the intensive work of various individuals and institutions, and particularly through the efforts of the newly established United States Biological Survey, more active exploration and improved methods of collecting greatly increased the number of known forms, until in 1901, when Miller and Rehn published a new list, the total, exclusive of sirenians and cetaceans, was raised to about 1450, an increase of 400 per cent. Continued field work with subsequent "revisions" as the material became adequate brought this number in 1912 to 2138 species and subspecies as listed in Miller's catalogue of that year, or nearly six times the number in True's list. Now, after another twelve years, and after including sirenians and cetaceans (previously omitted), the total is 2554, an increase of about 400 over 1912. This falling-off in the proportionate numbers added is a hopeful indication that our inventory of North American mammals is approaching completion. Indeed, it is safe to say that the mammal fauna of no other area of equal size is now so well known. For

this, no small measure of credit is due the United States Biological Survey for the thoroughness of its field work and the stimulus it has given in arousing a wider interest in the study of mammals. The leading part played by the Biological Survey and the National Museum is obvious when one reads that of these 2554 recognized species or subspecies, all but 171 are represented in the national collections, and that these collections contain the types of 1344.

In reflecting the advances made in the systematic study of North American mammals, the list shows equally wherein further and more critical attention is needed before it can be brought to the same degree of accuracy as that of the A.O.U. Checklist of birds. For although an encouragingly long list of genera, particularly of the rodents, has now been placed on a fairly satisfactory basis through recent monographic papers, there are many others of which this cannot yet be said. Thus it appears, if one were to take the listed names at face value, that North America supports seven distinct species of wolverene, chiefly, no doubt, because no one has had the temerity or the specimens to reduce the various specific names to subordinate rank. Again, of the four "forms" of polar bear credited to northeastern North America by Knottnerus-Meyer, the type localities of two are respectively Okak and Ungava Bay, Labrador, places not far enough apart to tax the travelling possibilities of a single bear. Sundry other groups, when a monographic treatment can be made, will doubtless be reduced to a more logical basis. To one who has not studied Doctor Merriam's great series of grizzly bears, it seems that there must be some other interpretation of the facts he has recently brought out in naming forty different species and one new genus from western North America. It is remarkable that of these forty or more species, the type localities of no less than sixteen are in British Columbia alone! If all the variations described are of truly specific value in the sense generally used, then the world does not elsewhere offer a parallel case of so many closely related large species living in so restricted an area. One cannot avoid the thought that the differences are due to individual or alternative methods of growth, or are comparable to family likenesses in ourselves, or in some other way are to be accounted for. Indeed, the author of the present List goes so far as to relegate *Vetularctos*, the supposed new genus, to the synonymy of *Ursus*. No doubt these and other difficulties will be finally solved in future "revisions" and the number of recognized species and subspecies reduced or upheld accordingly.

Noteworthy as new and helpful features of the present list are: changes in certain generic names now current to conform to the International Code; the introduction of English names in connection with the Latin names of larger divisions; the fuller use of subgeneric and of lesser "group" headings; the addition of the orders Sirenia and Cetacea; and the inclusion of many species now extinct but believed to have survived into the period regarded as geologically recent. In this last category fall many of the West Indian species lately made known from bones preserved in cave deposits or kitchen-middens. The omission may be noted, however, of the Cuban *Geocapromys columbianus* (Chapman), while no reference is made to recent opinions that this group of short-tailed species should stand as a full genus. For the first time, too, the family Hominidæ is included in the list, the native race,—*Homo sapiens americanus*,—as well as the adventive *H. s. sapiens* and the introduced *H. s. afer*, noted as now "widely established."

It is not clear however why *H. s. mongolicus* is excluded, in spite of recent legislation. Introduced species that are self-perpetuating outside of domestication, are also listed, including the two African monkeys and the Burmese mongoose in the West Indies (concerning the latter species the author of the list calls the reviewer's attention to the inadvertent use of *Mungos*, now restricted to the banded mongooses, instead of *Herpestes*—see this Journal, vol. 1, p. 27, 1919[1]). While it is not easy to draw limits in matters of this sort, the pig (*Sus scrofa*) might be included among the introduced species, since it has for many years been feral in Florida and as much a part of its fauna as the introduced species of *Rattus*. Finally, as another new feature, is an Appendix, prepared by Mr. A. J. Poole, in which are listed alphabetically under general headings (states or geographical divisions) all type localities mentioned in the catalogue. This should prove useful in many ways, particularly in planning field work for the collecting of topotypes; but in this connection it must be kept in mind that the type localities of forms placed in synonymy before the publication of True's list and not since revived are not mentioned.

From its very nature, a list of this sort with its abundance of citations, is more than usually liable to contain misquotations of name, reference, or locality but the comparatively few and unimportant misprints noted are proof of the care with which the work has been done. Indeed, most of these errors are due to original mistakes in the publications from which they are quoted and have to do largely with unfamiliar place-names in Central America or the West Indies. In anticipation of a later edition, the following misspellings may be pointed out.

p. 10, line 16, for Bayamon read Bayamo
p. 44, line 15, for Casetal read Cafetal
p. 45, line 25, for Imravalles read Miravalles
p. 66, last line, for Chiriquito read Chiriquicito
p. 84, line 7, for Miquihaana read Miquihuana
p. 140, line 30, for *filipensis* read *filipensis*
p. 290, line 5, for Cabezos read Cabezas
p. 323, line 10, and p. 383, line 9, for Angel de la Guardia read Angel de la Guarda
p. 398, line 22, for Laurence read Lawrence
p. 443, line 7, for Seiba read Ceiba
p. 444, line 11, for Gaudeloupe read Guadeloupe

I am indebted to Dr. Thomas Barbour, whose familiarity with Central American localities is considerable, for the suggestion that a future edition should also endeavor to establish a uniformity in the accentuation of Spanish names ending in a vowel, in which the last syllable is stressed instead of the penultimate. Such words should, strictly, have the printed accent, as El Guamá, Comondú, San Luis Potosí, Cuyabá, Samaná.

Altogether the new list is a most welcome summary and will go far toward placing the nomenclature of North American mammals upon a secure basis.

—*Glover M. Allen.*

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[1]The author has also requested that attention be drawn to the following additions and corrections:

Page 476. After *Sylvilagus bachmani cinerascens* (Allen) insert *S. bachmani*

Grinnell, Joseph, and Tracy Irwin Storer. ANIMAL LIFE IN THE YOSEMITE. AN ACCOUNT OF THE MAMMALS, BIRDS, REPTILES, AND AMPHIBIANS IN A CROSS-SECTION OF THE SIERRA NEVADA. Pp. i–xviii; 1–752; 60 plates (12 colored), 2 maps, and 65 figs. in text. $7.50. University of California Press. April 17, 1924.

The appearance of this substantial volume has been eagerly anticipated for some time, and few will deny that it sets a new standard for publications of this character. Strictly popular in scope, it yet embodies a vast amount of painstaking observation by two trained naturalists noted for their accuracy in field work, and hence contains information that is of as much interest to the advanced student as to the tyro who is in quest of nature lore.

The press work is fully up to the very high standard maintained by the University of California Press. The volume is plentifully illustrated, not only by colored plates from the brush of Allan Brooks, but by half-tones of photographs, figures, maps, and explanatory diagrams. The illustrations are especially rich in photographs of dead specimens in the flesh, showing the proportions and general appearance of the animal, and in figures of details comparing various characters, as the ears or tails—all of much value in field diagnoses. Especially helpful is a series of tables of occurrence, according to life zone, of all forms included. The six life zones occurring in the area are ruled into as many columns, each one being a different color. A black bar across these indicates the zonal distribution of each species, so that this may be determined by the reader at a glance. Incidentally, one is impressed with the extreme care that has been employed in determining such zonal distribution.

The portions of immediate interest to mammalogists are included in pages 1–21, 36–42, and 43–246. The first two of these portions have to do with introductory matter and a general discussion of the area, while the last concerns itself in detail with the 97 forms of mammals occurring, or having occurred in historical times, within the region.

The Yosemite area as here considered involves a strip of territory 89½ miles in length by 17½ in width, running from the eastward margin of the San Joaquin Valley across the Sierra to the vicinity of Mono Lake. Not all of this area is within the boundaries of the Yosemite National Park, nor is all of the park within the area. Only observations made and information gleaned actually within this rectangle are included in the present contribution. Work was begun in 1914 and no data secured after the last of 1920 were used; but field work was, of course, intermittent. Some interesting statistics regarding the results of work in the field are presented. Thus, 40 collecting stations were occupied, 957

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mariposæ Grinnell and Storer, Univ. Calif. Publ. Zool., vol. 17, p. 7, August 23, 1916. (Near El Portal, Mariposa Co., California.)

Page 486. Transfer *Odocoileus crooki* (Mearns) to the subgenus *Eucervus* (p. 484).

Page 488. In synonymy of *Odocoileus virginianus borealis* insert *Cariacus wisconsinensis* Belitz, Wisconsin Conservationist, vol. 1, no. 5, p. 1, November 15, 1919. (Wisconsin.)

Page 489. Transfer *Odocoileus virgultus* (Hallock) to the subgenus *Eucervus* (p. 485).

'man-days' were spent in the field, 2001 pages of notes were taken, and 4354 specimens and 700 photographs were obtained.

Of much interest is the chapter on the distribution of animal life in the region, with a popular and shrewd, though conservative, discussion of zonal matters. The extremely confused zonal situation upon the eastern flank of the Sierra is well handled, with a frank exposition of the disconcerting conditions there occurring. A chapter on the interrelations of living things deals in a popular manner with the fundamentals of ecology.

In the cases of such mammals as are represented by several subspecies, or even by closely related species with similar habits, there are only single headings of designation. Thus, the main portion of the work dealing with mammals begins with the heading "Moles. *Scapanus latimanus* (Bachman)," with a footnote in which are listed three subspecies, with short comparative descriptions. Similarly, the caption of the chapter pertaining to pocket gophers contains simply the generic name *Thomomys*, while the accompanying footnote sets forth briefly the comparative descriptions, with distributional and zonal notes, of the five forms, representing four species, of gophers encountered. The criterion for separating or for gathering under one general head forms that are fairly closely related, is the difference or resemblance in life habits. This plan is greatly to be commended in a work of this kind which is meant for the use, first of all, of the non-technical reader, and it is one that should be more widely followed in publications of a similar character.

At the beginning of the chapter on each species or group, as the case may be, there are a dozen or more lines in small type under two sub-headings. The first—*Field characters*—consists of a formal but concise diagnostic description of the external characters of the animal and similar matter, such as manner of life. The second—*Occurrence*—treats of the distribution, both geographical and zonal, throughout the region.

The main body of each chapter begins with a discussion, in narrative style, of the distribution of the animal within the Yosemite area, followed by a popular characterization. The remainder of the chapter treats of as many phases of the life history as it was possible for the authors to observe, strictly within the territory considered. Stomach contents and other food notes are recorded, burrows and nests are described, and the chapter closes with an exposition of breeding data. At the end of the volume there is a bibliography of three pages.

Caution and conservatism in the interpretation of facts are most commendable traits for a naturalist to possess. Nevertheless, the reviewer has gained the impression that such circumspection has been carried to a somewhat unnecessary length in the present volume. A naturalist's job is to accumulate facts in the field, and to interpret these facts to the best of his ability at his desk. Recklessness and impetuosity are to be severely condemned, but undue caution is a fault rather than a virtue. All this, however, is really of slight moment. The book fulfills its purpose to an exceptionally satisfying degree. The arrangement and general treatment are all that could be desired, and both the authors and the sponsoring institution are to be congratulated on the appearance of a useful piece of work that will forever remain to their credit.

—*A. Brazier Howell.*

Allen, J. A. CARNIVORA COLLECTED BY THE AMERICAN MUSEUM CONGO EXPEDITION. Bull. Amer. Mus. Nat. Hist., vol. 47, art. 3, pp. 73–281; 67 text figs., 73 plates, and map. April 11, 1924.

This technical account of the carnivorous mammals collected by Herbert Lang and James P. Chapin on the American Museum Congo Expedition was prepared shortly before Doctor Allen's death in 1921. It is "now published essentially as Doctor Allen left it, except for certain necessary changes made by Mr. Lang and the addition of figures made under Mr. Lang's supervision." The collection contains 588 specimens, which is doubtless the greatest number of African carnivores ever assembled for any one similar study. These specimens, furthermore, are nearly all from a limited region in the Ituri and Uele drainages, and the adjacent parts of the Belgian Congo, including stations both within and without the area of the great African rain forest.

Central Africa is not so rich in carnivores in general as are other parts of the continent, but is notable for its great variety of viverrine forms. The collection contains 33 species and subspecies, including one of Canidæ, three of Mustelidæ, 19 of Viverridæ, one of Hyænidæ, and 9 of Felidæ. Two genera and eight new species and subspecies have been described from it in this and previous preliminary papers.

In addition to the general report on the specimens in the collection, the paper includes numerous detailed nomenclatorial discussions, presented in the scholarly style characteristic of all of Doctor Allen's long list of contributions to this subject. New forms of *Helogale*, *Atilax*, *Crocuta*, *Leo*, *Panthera*, and *Leptailurus* are described, and complete redescriptions, with figures, are given of *Osbornictis piscivora* and *Xenogale microdon*, which had been first named in a preliminary paper.

The book is made up in the splendid style usual to publications of the American Museum of Natural History. A complete index of technical names mentioned would have added greatly to its usefulness; although this will doubtless be supplied for the whole volume, workers who use the carnivore report as a separate will miss it greatly. The text figures are numerous and show details of the skulls, teeth, and foot and nose pads. The plates are perhaps the finest we have ever seen in any similar report; the photographs of freshly killed animals, posed to show various parts of the external anatomy and color pattern to advantage, form, in themselves, a most valuable contribution. The colored plate of *Osbornictis* is most attractive. This will doubtless remain the most important work upon the carnivores of Central Africa for many years to come. Our great regret that Doctor Allen could not prepare similar reports on the remaining groups is tempered by the knowledge that the work is left in Mr. Lang's capable hands.

—*N. Hollister.*

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CORRESPONDENCE

BREEDING HABITS OF JACK RABBITS

Editor of the Journal of Mammalogy:

Dr. Charles T. Vorhies and the writer are collaborating in a study of the life histories of the antelope jack rabbit (*Lepus alleni*) and the Arizona jack rabbit (*Lepus californicus eremicus*). We find in the literature a distressing absence of information regarding the nests, young, and breeding habits in general of the jack rabbits. We therefore appeal to the members of the American Society of Mammalogists to submit for publication or send the undersigned such notes as they may possess on this subject or, for that matter, any other having to do with the life histories of jack rabbits.

Walter P. Taylor.

Box 402, University Station, Tucson, Arizona.

POSITION OF LIMBS IN THE SLIDING OTTER

Editor of the Journal of Mammalogy:

In the February issue of the Journal of Mammalogy there appeared an inquiry by T. W. Burgess as to the correct position of the limbs of a sliding otter. Apparently I was one of the first consulted by the artist who made the figure for the poster advertising merchandise that has had wide circulation among the Boy Scouts. Although the original picture was poor in some ways, the fore feet were shown bent back in correct position. Having had no personal experience on this subject I referred this matter to some of my colleagues. It so happened that none of them could base their opinion on first-hand observation, but evidently all of them, like myself, thought that the limbs might be directed forward. Suggestion, how-

ever, was made that a film depicting otters taken in the National Zoological Park at Washington by Mr. Arthur Fisher might prove of value in the discussion. Since then I have come across the following reference in the literature which ought to settle the question as it has the endorsement of two of our most careful observers:

". . . . On the ice they proceed by a series of what small boys call 'a run and a slide,' that is, they make several jumps and then slide ahead, flat on their bellies, as far as their impetus and the smoothness of the ice permit, and then do the same thing over again, and so on. And this mode of progression suggests a curious trait in the character of the Otter, *i.e.*, its fondness for sliding down hill. Dr. John D. Godman, in his well-known work on 'American Natural History,' [1826, vol. 1, p. 225] speaks thus of the habit: 'Their favorite sport is sliding, and for this purpose in winter the highest ridge of snow is selected, to the top of which the Otters scramble, where, lying on the belly with the fore-feet bent backwards, they give themselves an impulse with their hind legs and swiftly glide head-foremost down the declivity, sometimes for a distance of twenty yards. This sport they continue apparently with the keenest enjoyment until

fatigue or hunger induces them to desist.'" (Merriam, C. H. 1884, Mammals of the Adirondack Region, p. 89.)

This habit of sliding seems to be restricted to the American otter *Lutra c. canadensis* (Schreber) and its close northern relatives, also to the Newfoundland form *L. degener* Bangs. There seems to be no record of otters in the Eastern hemisphere performing such stunts (Millais, 1905, The Mammals of Great Britain and Ireland, vol. 2, p. 22). Game warden Sollach of Staudach, southeastern Bavaria (Brehm's Tierleben, 1915, vol. 12, Säugetiere vol. 3, p. 367) followed the fresh tracks of an otter *Lutra lutra* (Linnæus) for five hours in snow nearly six feet deep but never mentions its sliding. On a part of the Hochgern Mountains the otter climbed for three hours up over a pass about 4400 feet high and two hours down, always on very steep and rocky slopes, in order to reach a new fishing ground.

Perhaps the position the forelimbs of a sliding otter would assume is best shown by an excellent photograph of a European otter swimming up to the surface of the water in an article in *Wild Life* (Ward, Francis, 1913, vol. 1, p. 34). In this illustration, from which the above outline drawing is taken, the forelimbs are turned backwards and pressed close to the body.

Herbert Lang.

American Museum of Natural History, New York City.

SIXTH ANNUAL MEETING OF THE AMERICAN SOCIETY OF MAMMALOGISTS

The sixth annual meeting of the American Society of Mammalogists was held in Cambridge and Boston, Massachusetts, April 15–17, 1924. Day sessions were held in the Geological Lecture Hall, Harvard University Museum, Cambridge; evening sessions were in the Lecture Hall of the Boston Society of Natural History. Although only 37 members registered attendance, among them were representatives from 15 or more of the leading scientific institutions of America, and from 12 states, the District of Columbia, and Canada. The intensely interesting programs and lively discussions at the Society's meetings warrant a larger attendance While there may be minor advantages in small gatherings, it is hoped that members will take the annual meetings more seriously, since they are a vital part of the organization. The symposiums have been particulary well received, and it is planned to have another at the next annual meeting, which will be held in Washington, D. C., early in April, 1925.

At the business session officers were elected and committees appointed as indicated on the second cover page of the Journal. The Society voted to endorse and sponsor the publication of an English translation of the new edition of "Die Säugetiere" by Max Weber, provided arrangement for such translation and publication would be sanctioned by the author and his German publishers. The matter was detailed to the Committee on Anatomy and Phylogeny. It was also voted that the president appoint a chairman of a Committee on Wild Life Sanctuaries which shall last for a period of two years, the chairman to add to this committee. This committee is to make a study formulating policies for the preservation of predatory animals and to recommend the location of certain wild life preserves suitable for the preservation of such animals. The committee consists of Dr. C. C. Adams, chairman; Mr. E. A. Goldman; Mr. Vernon Bailey; Mr. Joseph Dixon; and Mr. Edmund Heller. The following resolutions were adopted:

(a) WHEREAS, Active propaganda for the destruction of so-called "vermin" and predatory mammals is being carried on throughout the country, and

WHEREAS, Much of this is advanced by arms and ammunition interests, and by others financially benefitted, and mainly by persons only superficially acquainted with these animals, or by misinformed persons; and thus much serious injury is done to wild life conservation; Therefore—

Be it Resolved: First, That the American Society of Mammalogists, which is a professional society of international membership of students of wild life, including practically all field naturalists who are interested in mammals, points out the danger which lies in such propaganda,

Second, That there exists no real occasion for a nationwide campaign for the destruction of predatory animals, and that this is particularly unwise because it furnishes a pretext for illegal hunting out of season,

Third, That copies of these resolutions be forwarded to other interested organizations, game and protective associations, and to all Federal and State agencies concerned.

(b) *Resolved*, That the American Society of Mammalogists indorses the Alaska Game Bill, introduced in the House of Representatives by Hon. Dan Sutherland, of Alaska, (H. R. 5949) and in the Senate by Hon. Peter Norbeck, of South Dakota, (S. 2559), and urges its immediate passage. This measure is essential to the future welfare and preservation of Alaskan wild life.

And Be It Further Resolved, that a copy of these resolutions be sent to Hon. Dan Sutherland; Hon. Peter Norbeck; Hon. G. N. Haugen, chairman of the Committee on Agriculture, House of Representatives; and Hon. George W. Norris, chairman of the Committee on Agriculture and Forestry, in the Senate.

The fifth annual report of the corresponding secretary summarized the status of the Society on April 16, 1924, as follows:

Names of new members acted upon April 16, 1924	63
Members elected by Directors December 10, 1923	18
Subscribers for the Journal added since May 15, 1923	19
Additional members and subscribers since May 15, 1923	100
Members May 15, 1923	586
Honorary members May 15, 1923	1
Subscribers May 15, 1923	81
Members delinquent 1922 dues May 15, 1923 (not receiving vol. 4 of journal)	23
Lost addresses of members May 15, 1923	2
Distribution of Journal May 15, 1923	643
Deaths of members since May 15, 1923	5
Resignations since May 15, 1923	11
Dropped on account of unknown addresses, April 16, 1924[1]	2
Journal cancelled on account of unknown addresses[2]	6
Elected 1923 members who failed to qualify	2
Subscriptions cancelled since May 15, 1923	1
Dropped for delinquency April 16, 1924	1
Members April 16, 1924	646
Honorary members April 16, 1924	1
Members delinquent 1923 dues, April 16, 1924 (not receiving vol. 5 of journal)	34
Members and honorary members receiving Journal April 16, 1924	613
Subscribers April 16, 1924	99
Distribution of Journal April 16, 1924	712
Net increase in distribution of Journal since May 15, 1923	69

[1] Moses R. Cooper and E. M. Prutzman.

[2] Theodore R. Beard, E. T. Blundell, Ralph E. Butler, L. W. Hudson, W. N. Martin, Robert H. Palmer.

PROGRAM

TUESDAY, APRIL 15

10:00 a.m.

Symposium: The scientific and economic importance of predatory mammals
(Arranged with the aid of the Committee on Life Histories)

A. SCIENTIFIC

1. General status of the predatory mammal problem. H. E. Anthony.
2. Scientific value of predatory mammals. Lee R. Dice. (Presented by Glover M. Allen.)

B. ECONOMIC

3. Predatory mammals, a practical problem in economics. W. B. Bell.
4. The predatory mammal problem and the balance of nature. E. A. Goldman.
5. Food predilections of predatory mammals. Joseph Dixon.
6. Predatory mammals as a source of fur supply. Ned Dearborn.

2:30 p.m.

Symposium: The scientific and economic importance of predatory mammals. (Continued)

C. CONSERVATION

7. The present status of the larger African carnivores. Herbert Lang.
8. The conservation of predatory mammals. Charles C. Adams.

D. GENERAL DISCUSSION

8:15 p.m.

Meeting of the Directors

WEDNESDAY, APRIL 16

10:00 a.m.

Annual Business Meeting

12:30 p.m.

9. The status of predatory mammals in national parks. M. P. Skinner. Thirty minutes.
10. Photographic cages for mammals. Ernest Thompson Seton. By title.

2:30 p.m.

11. Deer of the United States from a statistical standpoint. T. S. Palmer. Twenty minutes.
12. Experiences with wild animals. Ernest Harold Baynes. Forty minutes. Lantern slides.
13. Notes on scatology. Ernest Thompson Seton. By title.
14. The geologic history of the oreodonts. Malcolm R. Thorpe. Thirty minutes. Lantern slides.
15. A survey of the mammals of Ecuador. A résumé of the work now being carried on by the American Museum. H. E. Anthony. Forty minutes. Lantern slides.

8:00 p.m.

16. The fight to save the buffalo. Ernest Harold Baynes. Forty minutes. Lantern slides.

Following Mr. Baynes' lecture there was an informal reception in the Library of the Boston Society of Natural History.

THURSDAY, APRIL 17

10:00 a.m.

17. Comparison of ecological conditions in the West African rain forest with those of the British Guiana forest, with remarks on the mammal life. Herbert Lang. Twenty minutes. Lantern slides.
18. Variation in the cranial characters due to age in the African viverrine genus *Civettictis*. Herbert Lang. Ten minutes. Lantern slides.
19. American bats of the genus *Myotis*. Glover M. Allen. By title.
20. Small mammals from the Asiatic Expeditions of the American Museum of Natural History. Glover M. Allen. Fifteen minutes. Illustrated by specimens.
21. Notes on the habits of some Asiatic mammals. Clifford H. Pope. Fifteen minutes. Lantern slides.
22. The University of Kansas collection of mammals from the Santa Cruz formation of Patagonia. H. H. Lane. Ten minutes.
23. A new insectivore from the Santa Cruz formation of Patagonia. H. H. Lane. Ten minutes. Illustrated by specimen.
24. Mammal life in the heart of the Gaspé. R. M. Anderson. Thirty minutes. Lantern slides.

1:00 p.m.

Final business session

2:30 p.m.

25. Members assembled at the Colonial Club, Cambridge, and were escorted by the local committee to the Genetics Laboratories at Bussey Institution, Forest Hills, where they were the guests of Prof. W. E. Castle. Doctor Castle addressed the Society on "The evolution of colors in rodents," following which the members inspected the laboratories.

—*Hartley H. T. Jackson.*